

# SCIENCE

OCTOBER 13, 1950



NATIONAL ACADEMY OF SCIENCES

*ABSTRACTS OF PAPERS  
PRESENTED AT THE  
1950 AUTUMN MEETING*

TECHNICAL PAPERS

BOOK REVIEWS

NEWS AND NOTES



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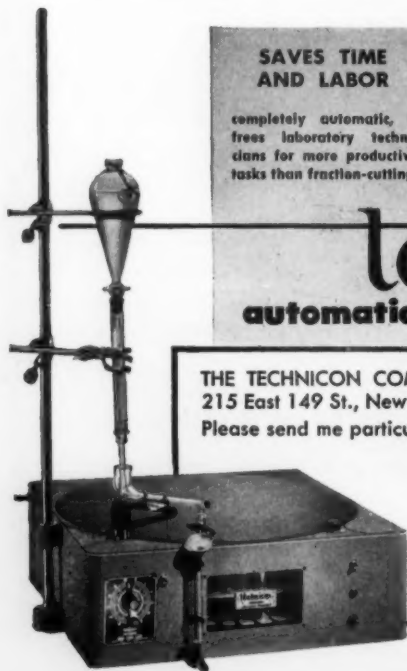
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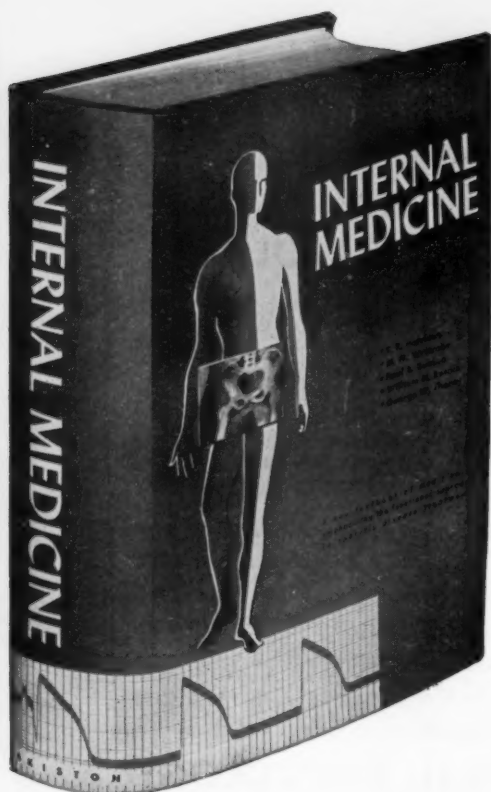
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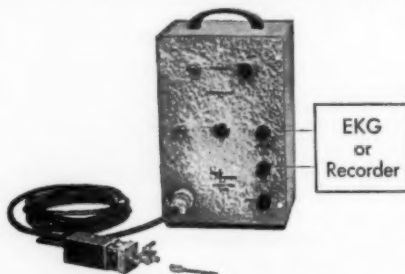
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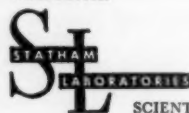
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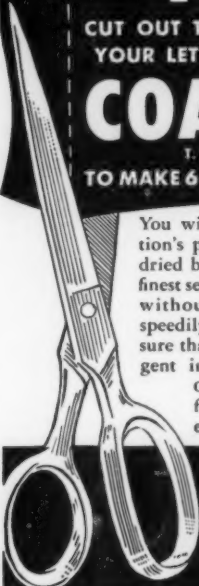
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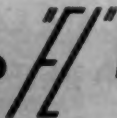
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## Wide Band Voltage Tuning of Magnetrons

D. A. Wilbur and P. H. Peters, Jr.

*General Electric Research Laboratory*

In the usual method of operation of a magnetron, an electrical resonance of the anode structure is the primary element in determining the frequency of oscillation. As the anode voltage is increased, the rotational velocity of the space charge surrounding the cathode is increased, and power output is obtained when the rotating space charge synchronizes with the natural frequency of the anode.

It has now been found that high-frequency power may be produced with the space charge rotating nonsynchronously with respect to the natural frequency of the anode circuit if the anode circuit is heavily damped by resistive loading and if the electron emission from the cathode is partially restricted.

The frequency of the oscillation so produced is determined primarily by the rotational velocity of the space charge and is found to vary linearly with respect to anode voltage. Tuning ranges in excess of 2 to 1 in ratio have been demonstrated at power levels of approximately 100 w. Ranges in excess of 4 to 1 have been attained at lower powers. The effect has been checked over a wide range of power levels and is not foreseeably restricted to any particular frequency range.

## The Properties of Pure Germanium

R. N. Hall, *General Electric Research Laboratory*

Germanium is a tetravalent element located immediately below silicon in the periodic table and is physically and chemically very similar to silicon. Although most of the recent interest in germanium is concerned with its unique electrical characteristics, the element exhibits a number of other interesting properties. The coefficient of thermal expansion is unusually low, being  $5.3 \times 10^{-6}/\text{deg C}$  near room temperature. The element expands by a factor of 1.22 upon solidification at its mp of  $940^\circ \text{C}$ . Binary phase diagrams of germanium with nearly all other elements (silicon is known to be an exception) show very little solubility of these elements in solid germanium.

Germanium is regarded as a semiconductor in the sense

that only a very small fraction of the electrons present can contribute to the flow of electricity. Free electrons may exist as the result of thermal agitation or because of the presence of donor impurities which add extra electrons or of acceptor impurities which remove bound electrons. In the latter case, the vacant electron site is free to move, and acts as a mobile positive charge, giving rise to what is called hole conduction. Germanium occupies an unusual place among semiconductors by virtue of the fact that the mobility of these free holes and electrons is an order of magnitude greater than that observed in other semiconductors.

In the absence of impurities, germanium has a resistivity of about 75 ohm cm at  $20^\circ \text{C}$  as the result of a few parts per billion of thermally excited holes and electrons. Donor or acceptor impurities when present in concentration greater than this cause a corresponding decrease in resistivity.

Donor and acceptor impurities fused to germanium act as sources of electrons and holes. Current flow between such contacts involves recombination and space-charge phenomena similar to those involved in gas discharges. The electrical characteristics of various combinations of donor and acceptor electrodes fused to germanium are discussed.

## Intrinsic Conductivity of Germanium

W. C. Dunlap, Jr., *General Electric Research Laboratory*

An experimental study has been made of the transition of the conduction properties of germanium from the impurity range to the intrinsic range. Among the properties studied were the variation of Hall coefficient and resistivity with magnetic field and the change of these characteristics with temperature, the variation of mobility figure ( $10^4 R/\rho$ ) with temperature, and the evaluation of intrinsic conductivity and activation energy for a number of single crystals, both *N*- and *P*-type. For high resistivity *P*-type material, a large variation of Hall coefficient with magnetic field was found to occur. This leads to an actual reversal of Hall coefficient, with increasing magnetic field at temperatures close to the transition point. This effect has been explained qualitatively in terms of the difference in change of mobility of holes and electrons in a magnetic field. To explain the effects quantitatively,

one must assume large inhomogeneities of resistance throughout the sample. Use of these effects for evaluation of homogeneity of germanium samples and application of the free electron theory of mixed conduction of electrons and holes to germanium are discussed.

Values for the intrinsic resistivity of various *N*- and *P*-single crystals ranged from 45 to 60 ohm cm; the activation energy ranged from 0.61 to 0.75, the most probable value being 0.72 ev. The magneto-resistance of germanium obeyed a  $T^{-2}$  law to a fair degree of accuracy. The ratio of electron to hole mobility was found to be about 1.50. Additional evidence was found that the "Hall mobility figure" for holes is about  $3,000 \text{ cm}^2/\text{v sec}$ , for electrons about  $4,500 \text{ cm}^2/\text{v sec}$ .

## Boride Cathodes

J. M. Lafferty, *General Electric Research Laboratory*

The thermionic emission properties of the borides of the alkaline-earth and rare-earth metals and thorium have been investigated. These compounds all have the same formula  $\text{MB}_2$  and the same crystal structure, consisting of a three-dimensional boron framework in whose inter-lattice spaces the metal atoms are embedded. The valence electrons of the metal atoms are not accepted by the  $\text{B}_2$  complex, thus giving rise to the presence of free electrons, which impart a metallic character to these compounds. This, together with the strong bonds between the boron atoms in the framework, produces a series of compounds which have high electrical conductivities and high thermal and chemical stabilities—ideal properties for a cathode material. When this structure is heated to sufficiently high temperature, the metal atoms at the surface evaporate away. They are, however, immediately replaced by diffusion of metal atoms from the underlying cells. The boron framework does not evaporate but remains intact. This process gives a mechanism for constantly maintaining an active cathode surface. Thermionic emission measurements made on these materials show the rare-earth metal borides to be superior to the others. The highest emission was obtained from lanthanum boride. Its emission constants for the Dushman equation were  $\Phi = 2.66 \text{ v}$  and  $A = 29 \text{ amps/cm}^2/\text{deg K}^2$ . This is higher than the emission normally obtained from thorium. Lanthanum boride cathodes are especially useful in applications where high current densities are required. They are also suitable for high-voltage applications because they stand up well under positive ion bombardment. Since they are not affected by air or moisture, and activate easily, they have found wide use in experimental demountable systems.

## Effects of Cathode Rays on Various Materials

Elliott J. Lawton, *General Electric Research Laboratory*

Work in this field was done in this laboratory as early as 1926. More recent work is being carried out at MIT and at the new Electronized Chemical Corporation.

An experimental cathode-ray unit in operation at the

General Electric Research Laboratory is capable of delivering an ionization dose of 1 million equivalent *r* units in 7 sec at a distance of 10 cm from the tube window and at 800 kv (peak) energy. The unit is a modified 1-mev standard resonance transformer type x-ray machine, employing a sealed-off type cathode-ray tube.

A dose of 1 million *r* units has been found to be lethal to most molds and bacteria. The absorption of  $10^6 \text{ r}$  units produces a temperature rise of approximately  $2^\circ\text{C/g}$  of water absorbed, which low value makes this means of sterilization an attractive one, in particular for use in cases of temperature-sensitive materials.

Although it is possible to sterilize foodstuffs so that they can be stored without refrigeration, the sterilization dose in some cases is sufficient to produce undesirable changes in odor, taste, and color. Enzyme systems, both in the natural and isolated states, are deactivated by cathode rays. Chemical changes are produced in other materials irradiated with cathode rays. Plants from seeds irradiated with electrons produce flowers that show color mutations. The maximum survival dose was found to vary with the different varieties of seeds and over a range of approximately 5,000–100,000 *r*.

## Neutron Production by a 50-Mev Betatron

G. C. Baldwin and F. R. Elder

*General Electric Research Laboratory*

Research, therapy, and other applications of x-radiation of voltages above nuclear binding energies require evaluation of the neutron intensities associated with the x-ray beams. Measurements have been made of neutrons generated by the GE 50-mev biased betatron, using the 44-sec radioactivity induced by slow neutrons in rhodium as detector. Survey of areas adjacent to the unshielded betatron showed a moderate neutron background from passage of the x-ray beam through target and tube walls. With shielding, measurements were made of photoneutron generation in various elements. A 50-mev x-ray flux producing 1 *r* below  $\frac{1}{8}$  in. of the lead yielded,  $1,860 \text{ Z}^2$  neutrons per mol; quanta of the order of 20 mev are chiefly responsible for the observed neutrons. The neutron energies average 2–5 mev. Some theoretical interpretations of the data are discussed. Relative shielding efficiency of various materials is considered. It is shown that, in therapeutic applications, the neutrons generated within a patient are the chief problem, but as they contribute a negligible fraction of the dose they do not constitute a limitation to high-voltage x-ray therapy.

## Nonferromagnetic Synchrotron

James L. Lawson, *General Electric Research Laboratory*

A new type of synchrotron (electron accelerator) is described in which the required magnetic fields are produced by nonferromagnetic means. Current-carrying coils in an appropriate arrangement supply the (separate) fields for the betatron and synchrotron phases of operation. The betatron phase accelerates particles from the

injection energy (about 80 kv) to about 2.5 million v where the particle velocity is nearly that of light. In this phase, acceleration takes place by means of the induced emf in the electron orbit path caused by the changing flux enclosed. In the ensuing synchrotron phase, acceleration is accomplished by means of the potentials obtained on r-f electrodes. In this operation, the electron is locked in its orbital path by the constant-frequency r-f source, and its ultimate energy is determined by the ultimate strength of the magnetic field at that orbit.

In the nonferromagnetic synchrotron at the Research Laboratory at General Electric, the peak electron energy is to be 300 million v, with a possible extension to considerably higher energies if operation at the design energy warrants the increase in power supply equipment.

This new method of synchrotron construction offers improvements in machine size for a given electron energy, in total stored magnetic energy for a given electron energy, and in the excellence of the magnetic field at the electron orbit.

## Evidence for Exciton-induced Photoelectric Emission from F-Centers in Alkali Halides

L. Apker and E. Taft

General Electric Research Laboratory

Alkali halides containing F-centers (electrons trapped in vacant negative ion lattice sites) exhibit photoelectric emission when irradiated with quanta of energy  $h\nu$  greater than about 2.5 ev. In the visible and near-ultraviolet ( $h\nu$  less than 5 ev), the photoelectrons arise from direct ionization of the F-centers by the incident quanta. The photoelectric yield is relatively small, of the order of magnitude  $10^{-4}$  electron per incident quantum. For larger quantum energies lying in the first fundamental absorption band of the pure alkali halide, the process becomes more complex and the photoelectric yield rises by a factor as high as fifty. An attractive hypothesis is that the incident quanta produce excitons (coupled electrons and holes) which migrate through the crystal and eventually ionize F-centers. Thus, the incident energy is more effectively concentrated on the F-centers, and the photoelectric efficiency is accordingly increased. The behavior of the emission at 90° K indicates that excitons are destroyed at free surfaces.

## The Attainment of Minimum Noise Figure in Ultra High Frequency Receivers

Clifford G. Fick and Robert L. Watters

General Electric Research Laboratory

This paper reviews briefly the advantages in the use of the noise figure concept for specifying receiver sensitivity performance. It then evaluates the basic types of radio frequency amplifiers in terms of their noise figure capabilities. As operating frequencies increase, such factors as transit-time loading and cathode-lead-inductance load-

ing must be taken into consideration in determining noise figure capability. Although an optimum mismatch of the amplifier input and antenna circuits will produce a lower noise figure than for a matched input, this is not considered to be a practical, attainable operating condition in receivers designed to provide simple tuning over a wide frequency range. Information is presented to show the effects of various amounts of mismatch on noise figure. Vacuum tube characteristics of most importance to minimum noise figure attainment are discussed, and some representative performance data are given.

## The Determination of the Molecular Structure of the Halogenosilanes by Microwave Spectroscopy

A. Harry Sharbaugh, General Electric Research Laboratory

Microwave spectroscopy is concerned with the detection and precise measurement of the absorption frequencies of microwave energy (1-cm wavelength) in gases. Such a procedure is analogous in principle to that employed in infrared and visible spectroscopy, except that it is done in a different region of the spectrum and so requires completely different techniques. A microwave spectroscope has several important advantages over those operating in the infrared and visible regions, viz., (1) the resolution is about 1,000 times better, and (2) absorption frequencies may be measured with the uncanny accuracy of 1 part in a million. These advantages permit the bond angles and lengths between atoms in a molecule to be determined to a much higher degree of accuracy than has been previously attainable from infrared and electron diffraction techniques. This paper includes a brief discussion of the experimental method and the manner of reducing the data to yield the molecular structures.

The halogenosilanes\* are of interest to the General Electric Company because they represent basic starting materials for the silicone industry. They belong to a class of molecules, known as symmetric tops, whose molecular structure is completely specified by three parameters; viz., the Si-H distance ( $d_{\text{SiH}}$ ), the Si-X distance ( $d_{\text{SiX}}$ ), and the bond angle  $\angle$  H-Si-H. Table 1, where a com-

TABLE 1  
COMPARISON OF EXPERIMENTAL ERROR ON THE  
STRUCTURAL PARAMETERS OF  $\text{SiH}_3\text{Cl}$

	Microwave data	Electron diffraction data
$d_{\text{Si-Cl}}$	$2.048 \pm .001 \text{ \AA}$	$2.06-.05 \text{ \AA}$
$d_{\text{Si-H}}$	$1.50 \pm .03 \text{ \AA}$	Yields no information
$\angle$ H-Si-H	$110^\circ 57' \pm 1^\circ$	Yields no information

parison of the experimental accuracies obtainable from microwave and electron diffraction data is given, demonstrates the great possibilities of the method. The structural results obtained from the other members of this series of compounds are discussed.

\* A halogenosilane is the generic name given to the series of monohalogen derivatives of silane having the formula  $\text{SiH}_3\text{X}$ , where X may be a fluorine, chlorine, bromine, or iodine atom.

## Chronic Remote Nerve Stimulation Technique in Physiological Investigation

John J. Farrell, *Albany Medical College*  
and

James M. Lafferty, *General Electric Research Laboratory*

A method of stimulating any given nerve, and thereby any body organ that has a nerve supply, in an intact, unrestrained, unanesthetized animal for weeks or months at a time is described. The method utilizes radio waves and a buried receiving unit. The 1.25-in. diameter radio receiver is buried beneath the skin of laboratory animals. The receiver is connected by a lead wire to an electrode around any peripheral or autonomic nerve under investigation. The animals so prepared then live in an 8-ft diameter "radio-field cage," where they can roam at will. The "radio-field cage" is essentially a circular antenna connected to a radio transmitter. By means of a square wave generator, the radio waves generated by the transmitter are so modulated that the receiving unit delivers to the nerve via the electrode, a d-c rectangular wave whose repetition rate, pulse width, and intensity can be controlled at will.

Such an investigative setup allows one to stimulate specific body organs—e.g., the stomach—in order to study the physiological effects of the nervous system on that organ. It also permits one to try to stimulate the emotional and nervous backgrounds that are such a prominent feature in clinical conditions like peptic ulcers of the stomach and in high blood pressure.

A brief résumé of attempts to reproduce clinical pathological states in laboratory animals is given.

## Radiographic Gall-Bladder Contrast Agents

S. Archer, *Sterling-Winthrop Research Institute*

Several series of organic iodine compounds were prepared and tested for their ability to render the gall bladder opaque to x-rays. On the basis of the results an attempt is made to point out the structural features that are required for good visualization.

## The Coxsackie Viruses

Gilbert Dalldorf

*Division of Laboratories and Research*  
*New York State Department of Health, Albany*

In 1947 we discovered a group of viruses that seem to be common infections of man. Their existence had not been seriously suspected and, contrary to the traditional search for agents responsible for well-known diseases, we have in the present case discovered the agents before discovering the diseases they may cause.

The Coxsackie viruses are frequently associated with poliomyelitis and were discovered in the feces of poliomyelitis patients. They have since been found associated with poliomyelitis by many other workers in many parts

of the world, but it is not clear whether they play an important role in poliomyelitis, with which quite different viruses are concerned. Moreover, there is equally good evidence of their association with another disease, epidemic pleurodynia, for which no causative agent has been established, and they have also been found under various other circumstances.

The Coxsackie viruses have unusual properties. Their tardy discovery is probably due to one of these characteristics, namely, that they may be experimentally propagated only in immature mice and hamsters. Such test animals had rarely been used. A second peculiar property is that although they cause paralysis in suckling mice they do so by destroying the skeletal muscles rather than the nerve cells. They are also uncommonly small, probably no larger than 10 m $\mu$ . This is the size of poliomyelitis virus, and the two may be the smallest of the human pathogens.

Poliomyelitis and Coxsackie viruses are similar in other respects. Both are very durable. They are stable in glycerol for years. They are little affected by a wide range of pH. Both occur in the feces and frequently both may be found in the same fecal specimens. They are intimately associated in nature.

The association of Coxsackie viruses with poliomyelitis is our particular interest. It seems probable that the summer epidemics of poliomyelitis are actually mixed epidemics in which both viruses play a part. The Coxsackie viruses account for some of the illnesses. Perhaps the relationship is still more intimate and some cases are mixed infections. There is a natural tendency to oversimplify the etiology of infectious diseases. We do know that some are actually complex infections, that two different pathogens are required to cause illness. And it has been known for a dozen years that certain infectious diseases are rendered less severe by simultaneous infection with a second agent. Thus the association of the newly discovered Coxsackie viruses and the well-known poliomyelitis viruses raises a number of questions of considerable interest.

## Quaternary Ammonium Salts as Antibacterial Agents

Bernard L. Zenitz, *Sterling-Winthrop Research Institute*

Numerous quaternary ammonium salts belonging to the broad class of compounds termed surface-active agents have been described in the literature. Of these, many have been found to possess antibacterial activity.

A summary of some of the various chemical types that have found commercial application as germicides and sanitizing agents is given, and the relationships between chemical structure and antibacterial activity are pointed out.

Recently, a new series of aryloxyalkyl quaternary ammonium salts has been synthesized, and their antibacterial properties have been evaluated. A brief description of the synthesis and a comparison of the activity of some of the members of this series are given.

## Two Antifungal Agents Produced by a Soil Actinomycete

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Division of Laboratories and Research  
New York State Department of Health, Albany

Two agents active against fungi have been obtained from a soil actinomycete. The one is extractable from the culture fluid and somewhat resembles actidione in chemical and biologic properties; the second is extractable with alcohols from the surface growth on liquid medium and differs from other antibiotics within our knowledge. The latter agent, tentatively designated fungicidin, is effective *in vitro* against a large number of nonpathogenic and pathogenic fungi, including *Candida albicans*, *Cryptococcus neoformans*, *Histoplasma capsulatum*, *Blastomyces dermatitidis*, *Coccidioides immitis*, *Paracoccidioides brasiliensis*, *Trichophyton rubrum* (*purpureum*), and *T. mentagrophytes* (*gypseum*). The agent has not shown activity in much higher concentrations against some of the common bacteria such as *Staphylococcus aureus*, *Salmonella paratyphi* B, *S. typhosa*, *Shigella paradysenteriae*, and *Bacterium coli*. Crude preparations of fungicidin, injected repeatedly in sublethal doses into mice infected with *C. neoformans*, prolong the life of the animals beyond that of the untreated controls.

Because of its unique *in vitro* properties, the therapeutic capacity of this antifungal substance (fungicidin) is under experimental investigation.

## Ortho-Alkoxy Derivatives of Procaine as Local Anesthetics

R. O. Clinton and F. P. Luduena  
Sterling-Winthrop Research Institute

A new type of substitution in the nucleus of procaine has been studied in the Sterling-Winthrop Research Institute. We have synthesized and tested in this connection various series of ortho-substituted para-aminobenzoates and some of their analogs. Based upon laboratory results, certain of these compounds are more potent than tetracaine or dibucaine, the two most active local anesthetics in clinical usage at the present time.

In the present work the local anesthetic activity was studied by the sciatic nerve block method in guinea pigs, the irritancy was studied by intradermal injection in rabbits, and the toxicity ( $LD_{50}$ ) was determined by intravenous injection in mice. These values were converted to "procaine ratios" by division of the threshold anesthetic concentration, the threshold irritant concentration, and the  $LD_{50}$  values for procaine by the corresponding values for the compounds under test.

The substitution of an ortho-hydroxy group in procaine brought about a substantial increase in activity, whereas the substitution of an ortho-methoxy group gave only a small increase in activity. However, as the size of the ortho-alkoxy group then increases further, the activity also increases rapidly. The ortho-hexyloxy compound,

for example, is about 100 times as active as procaine. The toxicity of these compounds is roughly proportional to activity, and with the exception of the ortho-methoxy compound they appear to be less toxic than procaine on an activity basis.

The local irritation appears to be independent of activity or toxicity. The most active compounds show a very favorable activity/irritation ratio. Thus, the ortho-propoxy analog is about ten times as active as procaine and only twice as irritating.

## Interaction of Beryllium with Enzymes

Friedrich W. Klemperer, Edward L. Trudeau Foundation

Recent reports have indicated a high toxicity of beryllium to animals and man. Because beryllium exerts its toxic effect in very low concentrations, it appeared possible that this effect depended on inhibition of some enzyme by beryllium; therefore the effect of beryllium on a number of enzymes was studied. It was found that beryllium in concentrations as low as  $10^{-4}$  M inhibited alkaline phosphatase. None of the other enzymes tested were inhibited by concentrations of  $10^{-4}$  M or below. The enzymes studied were: acid phosphatase, adenosine triphosphatase, carboxylase, arginase, carbonic anhydrase, uricase, and aldolase. It was also found that beryllium had no influence on the oxygen uptake by tissue slices or on glycolysis by muscle extracts.

## Maximum Oxygen Consumption for Work Periods of Six Minutes' Duration in Normal and Pathological Subjects

George W. Wright, Edward L. Trudeau Foundation

The maximum ability of the human engine to expend energy at a sustained rate portrays the capacity of the human organism to perform as an integrated unit and provides a criterion whereby its excellence or impairment may be estimated. The human engine differs from man-made internal-combustion machines in that, although all the energy developed must ultimately be accounted for in terms of oxygen utilized in combustion, in the human being energy can for a limited time exceed the rate at which oxygen is being utilized. It is known that the maximum of sustained physical performance by man depends directly upon his ability to remove oxygen from the respired air during the actual work period. This ability in turn depends upon the integrity of the respiratory and circulatory systems and of the blood and active tissues.

The quantity of oxygen removed per minute from the respired air during the fifth and sixth minute of the most intense exertion tolerable for 6 minutes on the treadmill was measured in 41 normal men between the ages of 25 and 45. The data are as follows: the mean of oxygen expressed in l/min/sq m of body surface was 1.425 l (S.E. of 0.030 l) and a standard deviation of 0.185 l (S.E. = 0.020). The correlation coefficient between this function and age in years was  $-0.014$  (S.E. = 0.097). The regression formula for this correlation is: Liters of



oxygen/min/ $M^2 = 1.855 - 10.41 \times \text{age}$  in years. The coefficient of variation for this formula is 12.5 percent. The wide variation between normal persons in this ability diminishes the sensitivity of this test and at the same time indicates the difficulty one faces in attempting to assay the normality of an individual. Study of this ability in persons suffering from pulmonary disease demonstrates that, although many have impairment of maximum ability to expend physical energy, others retain this ability to a degree comparable to normal persons in spite of evidence that a quite extensive anatomical abnormality exists.

## The Significance and Prevalency of Subclinical Amebiasis

E. W. Dennis and D. A. Berberian

*Sterling-Winthrop Research Laboratory*

The average incidence of infection with *Endamoeba histolytica* in the United States is not less than 13 percent. Clinical amebiasis and deaths have been reported from all parts of the nation, but very few "positive" cases come to the attention of physicians. In a recent survey of a presumably normal population sample of the Albany (N. Y.) area, the incidence of *E. histolytica* was 8.9 percent. Analysis of the records of 34 positive and 100 negative subjects shows that only 3 of the positive were without observed signs or symptoms referable to the gastrointestinal tract. Irregular bowel movements (more than 2 stools daily, intermittent diarrhea, alternate diarrhea and constipation, or chronic constipation), associated with abdominal tenderness, dominated the pattern in more than 70 percent. Among the control group, less than 10 percent presented any signs or symptoms referable to the gastrointestinal tract. The results of treatment and the importance of case finding in industrial organizations are discussed.

## A Mechanism for the Origin of Cancer Foci

J. C. Fisher and J. H. Hollomon

*General Electric Research Laboratory*

It is suggested that a single cancer cell surrounded by normal tissue cannot initiate malignant growth, and that tumors appear at locations where for one reason or another a critical number of cancer cells are bunched together. The idea behind the critical-size concept is that individual cancer cells in normal tissue are bathed in normal chemistry, whereas a cancer cell surrounded by others of its kind is bathed in abnormal chemistry, where malignant growth no longer is inhibited.

The mutation theory of cancer has had difficulty in explaining the rapid rise in cancer incidence with age, for mutation rates should remain substantially constant with time. When the critical size concept is introduced, however, a constant rate of random mutation leads to the relationship  $N \sim t^p$ , where  $N$  is the number of cancers in a population,  $t$  is the age of the population, and  $p$  is the

number of cells in a critical-size colony. This relationship, with  $p \approx 6$ , is followed very well for the over-all incidence of cancer in humans, and with  $p \approx 4$  for mammary cancer in mice.

Experiments with carcinogenic materials support the critical-size hypothesis, as do observations concerning the location of metastases, and studies of the influences of cuts and burns. The main contributions of the critical-size viewpoint of cancer initiation are that it correlates and systematizes many previously unrelated facts, gives new life to the mutation theory of cancer, and raises new questions that might not otherwise have been asked.

## Empirical Analysis of Viscosity Data

H. Tracy Hall, *General Electric Research Laboratory* and

Raymond M. Fuoss, *Yale University*

The equation generally used to interpret data obtained in variable head capillary type viscometers is the Wilberforce equation. This equation, which includes kinetic energy and end-effect corrections, can be rearranged to an equation in which apparent fluidity is linear in driving pressure. An additional term, also linear in pressure, is produced by drainage errors. A method is described for the experimental evaluation of these corrections.

Polystyrene, and polystyrene and polyvinylpyridine solutions exhibit a fluidity that varies linearly with pressure after the above corrections have been made. This residual variation is ascribed to distortion and/or orientation of the polymer molecule. Analysis of the data permits description of the shear dependence in terms of a single arbitrary constant  $k$ , the shear constant.

## A General Equation for the Entropies of Aqueous Ions

Wendell M. Latimer, *University of California, Berkeley*

The experimental values for the entropies of the positive aqueous ions, 26 cases in all, including the ion types  $M^+$ ,  $M^{+2}$ ,  $M^{+3}$ , and  $M^{+4}$ , are in good agreement with the equation

$$S_{298.15}^\circ = 3/2 R \ln \text{at.wt} - \frac{59Z}{r + 0.85} + 40,$$

where  $Z$  is the charge on the ion and  $r$  the ionic (crystal) radius. The entropy values, referred to  $S_{298.15}^\circ = 0$ , vary from  $-80$  to  $+35$ , and  $r$  varies from  $0.6$  Å to  $1.4$  Å. In most cases the agreement between the experimental values and the values from the equation is within 2 entropy units. The experimental value for  $Ag^+$ , however, is about 8 units low. The equation implies that the radius of the ion in aqueous solution is proportional to the ionic crystal radius, and this probably is not true in the case of  $Ag^+$ , with which there is doubtless some bond formation by water.

The second term in the equation is essentially the entropy of hydration. Since the free energy of hydration, as given by the Born equation, is a function of  $Z^2/r$ , and



the entropy is the temperature coefficient of the free energy, it is surprising that the entropy is a function of  $Z/r$ . This is a point of considerable theoretical interest and directs attention to the physical interpretation of the two quantities.

## The Kinetics of the Thermal Decomposition of Diborane

L. V. McCarty, J. K. Bragg, and F. J. Norton  
General Electric Research Laboratory

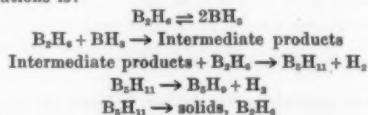
A number of hydrides of boron, compounds of the general formula  $B_xH_y$ , are known. Certain of these decompose or react readily at temperatures near  $100^\circ\text{C}$ ; in such thermal reactions perhaps all boron hydrides play some role. Consequently, the thermal decomposition of any boron hydride presents an intricate problem in reaction kinetics, whose solution involves establishment of a complicated mechanism for the reaction. Diborane ( $B_2H_6$ ) is a gaseous hydride of boron which undergoes rapid decomposition at  $100^\circ\text{C}$  and may be used as a starting material for preparation of other boron hydrides.

The kinetic studies of the thermal decomposition of diborane reported here are of three kinds. First, the rate of increase of total pressure has been measured as a function of temperature and initial pressure. Three conclusions are drawn from the results: the order of the rate-controlling step is 1.5; the reaction is homogeneous in glass; and the activation energy of the rate-controlling step is  $27.4 \pm 0.7$  kcal/mole.

Second, the rate of formation of hydrogen has been measured. The results confirm the value 1.5 of the order, and indicate an activation energy of  $25.5 \pm 0.5$  kcal/mole. The difference between activation energies is due to temperature effects on secondary reactions.

Third, the mass spectrometer has been used to follow the reaction; in this way the concentrations of several participant species were measured. It is concluded (1) that the order of the step controlling the rate of disappearance of diborane is 1.5, (2) that dihydropentaborane ( $B_5H_{11}$ ) appears to be an intermediate in the formation of most other boranes from diborane, and (3) that the formation of pentaborane ( $B_5H_9$ ) from dihydropentaborane is probably a simple first order step.

The reaction scheme proposed to account for these observations is:



## Newer Curarelike Compounds

C. J. Cavallito and J. O. Hoppe  
Sterling-Winthrop Research Institute

The curarimimetic activity of a series of 2-mono- and 2,5-bis-dialkylaminoalkylaminobenzoquinones and their

quaternary salts has been found to be related in the bis-series to the distance between basic nitrogen atoms and to the ionic bonding radius of the amine or ammonium groups. In the 2-mono-series, activity is related to the presence of a basic or cationic group at an optimum distance from an iminoquinone structure capable of bonding by chelation.

## A New Class of Living Microchemical Reagents: The Chrysomonads

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Haskins Laboratories

Many important cell constituents cannot be measured except as they occur in essentially free condition. Cell constituents such as vitamins often occur bound up in large molecules and are unavailable in this form to microorganisms used for assay. Sometimes the metabolites are stable enough for chemical digestion to be useful, but frequently these methods are too drastic to be practical. Where animals can be used for assay purposes, susceptibility to this kind of chemical inactivation is usually not a handicap, since the animal's digestive enzymes may allow full utilization of bound metabolites. Microorganisms that ingest food as solid particles are an economical type of animal to use. In looking for new types of biochemically useful micro-animals, we were led to investigate the chrysomonads, a brown-pigmented group of algal flagellates, as a result of our observations that the photosynthetic flagellate *Euglena gracilis* requires vitamin  $B_{12}$ . Many chrysomonads, unlike *Euglena*, are known to feed on particulate matter such as bacteria. With the aid of information furnished by E. G. Pringheim, two strains of *Ochromonas* were obtained in pure culture. They proved to require at least 3 amino acids, several known vitamins (including  $B_{12}$ ), and several nucleic acid components (adenine, guanine, uracil) in addition to unidentified factors. Preliminary tests show that these flagellates have a definite ability to satisfy several of their requirements from high-molecular compounds; e.g., their purine and pyrimidine requirements are satisfied by intact nucleic acids as well as by the free bases. The question arises whether organisms with such impaired synthetic powers, although provided with plastids, can carry out a conventional photosynthesis.

## Decomposition of Lauroyl Peroxide in Benzene and Diethyl Ether

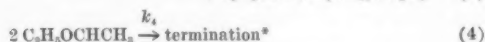
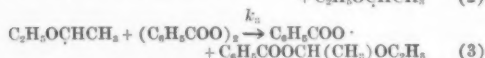
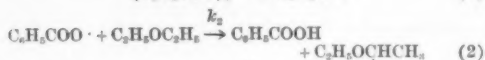
W. E. Cass, General Electric Research Laboratory

Benzoyl peroxide dissolved in an organic solvent undergoes thermal decomposition into free benzoate radicals as follows:



The work of Nozaki and Bartlett and of Cass showed that the rate of decomposition of benzoyl peroxide in solution varied greatly, depending upon the solvent. In order to

explain the acceleration of rate in "fast" solvents (ethers, amines, alcohols, and phenols) the idea of "induced decomposition" of the peroxide was evolved. In induced decomposition, radicals derived from the solvent are believed to attack undecomposed benzoyl peroxide, forming a neutral molecule and a new peroxide-derived radical. A mechanism proposed for the induced decomposition in ethers involves the following steps (for diethyl ether) :



\* Other termination steps are possible.

Reactions (2) and (3) constitute a repeating chain mechanism. The isolation of the products shown in (2) and (3) in high yield gave support to the above mechanism.

**Decomposition of lauroyl peroxide in benzene and diethyl ether.** This work was undertaken to find out if lauroyl peroxide, an *aliphatic* diacyl peroxide, exhibited induced decomposition as does the aromatic diacyl peroxide, benzoyl peroxide. Lauroyl peroxide was found to decompose eight times as rapidly in diethyl ether, a typical fast solvent, as in benzene, a slow solvent. The products of reaction of lauroyl peroxide with diethyl ether were found to be carbon dioxide, hendecane, and the acylal, 1-ethoxyethyl laurate. The kinetics and products of reactions are believed to support the idea of an induced decomposition of lauroyl peroxide in diethyl ether.

Two points are of particular interest. First, the decomposition of lauroyl peroxide followed first order kinetics. This gives support to the idea of "retardation by aromatic products." Second, essentially no lauric acid was formed; i.e., decarboxylation of the intermediate laurate radical,  $C_{11}H_{21}COO \cdot$ , was practically complete. This indicates a difference in stability between the aromatic and aliphatic radicals.

Peroxides of this type are used industrially as initiators for vinyl polymerization.

## Preliminary Studies on the Solubility of Iron in Liquid Sodium

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Knolls Atomic Power Laboratory  
General Electric Company

Preliminary measurements of the solubility of iron in liquid sodium have been made over the range 231°–483° C, by heating Na in an iron vessel in an argon atmosphere and sampling the fluid at temperature. The sodium obtained in this way was dissolved in alcohol,

and the iron content measured spectrophotometrically using the  $\alpha, \alpha'$ -dipyridyl color reaction.

The equilibrium solubility data on 33 samples can be fitted, by the method of least squares, to the linear equation

$$S_T^\circ = -1.47 + 0.030 T$$

where  $S_T^\circ$  is the equilibrium solubility in parts per million by weight at a temperature  $T$  degrees C. The probable error in the measurements is  $\pm 1.7$  ppm. From this equation, the solubility is 1.5 ppm at 100° C, and 13.5 ppm at 500° C. The heat of solution of Fe in Na, computed from the temperature coefficient of solubility, is  $2496 \pm 385$  cal/mole ( $\pm 15$  percent).

These results are compared with the data on the solubility of Fe in Hg. The data are analyzed from the point of view of solution theory, and it is found that (1) in both the Fe-Hg and the Fe-Na systems the activity coefficients of iron are large and positive, and (2) the entropy of mixing of Fe with each of the two liquids is greater than that computed by the ideal solution laws, and is approximately the same in Hg and Na.

## Synthetic Speech: A Study of the Auditory Perception of Complex Sounds

Franklin S. Cooper, Alvin M. Liberman, and John Borst  
Haskins Laboratories

Research on the perception of complex patterns of sound in general, and of the sounds of speech in particular, is greatly facilitated by a device that converts spectrographic displays into sound. The displays from which the sounds are produced may be either photographic copies of spectrograms of actual sounds or wholly synthetic "spectrograms" drawn by hand. This provides a very flexible arrangement for altering the sound in frequency, intensity, or time; and of course one can by listening tests determine how these alterations affect the perception. The method is a convenient one since the sounds can be manipulated conceptually and experimentally as relatively simple visual patterns. The audiovisual transformation implied in this procedure is discussed, and illustrated with sound recordings. Also, research applications of the equipment and techniques to studies in the perception of speech are presented.

## Radiography in Corrosion Studies

Herman A. Liebhafsky and Arthur E. Newkirk  
General Electric Research Laboratory

The annual cost of corrosion is so great that it is desirable to explore every promising technique for the investigation of corrosion processes. Among the most feared of these processes is pitting, which—being a form of localized attack—is well suited to investigation by methods such as radiography that depend upon the absorption of x-rays.

To illustrate the value of these methods, the pitting of three kinds of stainless steel in ferric chloride solution at room temperature has been studied. Radiographs have been obtained that show how pitting varies with the kind of steel and with the degree of cold deformation. Furthermore, it has been possible to demonstrate that the direction of attack can be profoundly influenced by gravitational forces and by the occurrence of crevices. Although the radiographs largely confirm past experience, they provide much detailed evidence that might escape visual observation, as a comparison with corresponding photographs will show. Finally, it has been possible to measure the rate of pit growth on specimens continuously immersed, an important fact because removal of the specimen from ferric chloride solution can stop altogether the growth of particular pits. The technique employed could be used to measure, in favorable cases, the rate of pitting in closed systems.

### The Limiting Negative Pressure of Acetic Acid and Benzene in Relation to Temperature

Lyman J. Briggs, *National Bureau of Standards*

The limiting negative pressure of water is markedly influenced by temperature, dropping rapidly as the freezing point is approached. Is this a characteristic of other liquids?

The limiting negative pressure curve of dry benzene vs. temperature resembles that of water in this respect. The graph rises sharply from the mp of benzene (5.5° C) to a rather flat-topped maximum of about -150 bars. Donaghue, Vollrath, and Gerjouy obtained one reading of -159 bars for benzene in a sealed tube with a residual gas pressure of only  $7 \times 10^{-6}$  mm Hg. The maximum negative pressure of benzene is thus seen to be far below that of water (-275 bars).

Glacial acetic acid, on the other hand, shows only a slight increase in the limiting negative pressure between the mp (16.6° C) and the maximum value observed, -285 bars at 22.5° C. This is slightly higher than the maximum observed for water. Acetic acid, however, exhibits a minimum value of 28° C and a second (lower) maximum near 40° C.

The centrifugal method previously described was used throughout these measurements. To reduce the evaporation of the volatile liquids, the open ends of the legs of the capillary tube were brought back near the spin axis. Evacuated sealed tubes were also used.

### Mechanism of Nonlinear Luminescence in Sulfide Phosphors

Shepard Roberts, *General Electric Research Laboratory*

The light emitted by a phosphor is in most cases proportional to the intensity of the ultraviolet excitation. However, quite a different effect is observed in zinc-cadmium sulfide phosphors. Constant efficiency is approached at extremely weak intensities, and a much

higher constant efficiency is reached at moderate intensity. In the intervening intensity range the emitted light increases much more rapidly than the ultraviolet excitation. In an extreme case, the emission increases as the 3.5 power of the excitation.

The observed results may be interpreted quantitatively by a detailed model of the impurity centers responsible for luminescence and of the centers responsible for quenching the luminescence, as well as of the electron traps present in the phosphor. Two energy states of the activator or luminescent center—silver for example—need to be considered, namely, the ground state and the excited, or metastable, state. An excited electron either may be thermally activated to the conduction band or it may return to the ground state by the emission process. The quenching, or "killer," centers—cobalt for example—have a normally unoccupied energy state which can capture electrons from the conduction band and which can then be emptied by hole conduction in the filled band. The traps have their usual function of catching conduction electrons, holding them and then releasing them again as a result of thermal activation. By considering all these factors together, a quantitative explanation has been given for the experimental results. This has made it possible to calculate energy values of some of the states and to compare these results with other data.

### Dependence of Luminescent Efficiency on Activator Concentration

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The amount of light emitted from impurity-activated luminescent solids for a given energy input generally increases with impurity concentration at low concentrations, passes through a maximum, and then decreases more or less gradually at higher concentrations. The optimum activator concentration depends on the constitution of the phosphor, the temperature, and the type of excitation energy.

The present work generalizes a previously published analysis of efficiency vs. activator concentration to include the effects of temperature and of different types of excitation energy—cathode rays, x-rays, and short- and long-wave ultraviolet. Data on a variety of inorganic phosphors are successfully correlated by the theory.

The important physical concepts involved in the formulation are as follows: (1) Incident energy can be absorbed by (a) exciton formation, (b) excitation of electrons to the conduction band, and (c) excitation to excited impurity levels. The relative contribution of each mechanism depends on the type of excitation. (2) Only activators not near other activators are luminescence centers. Activators situated near other activators tend to lose their energy by a radiationless process which is favored by smaller distance between activators and by higher temperature. (3) Capture of the energy, made available by one or more of the three primary mechanisms by radiative activators, competes with capture by nonluminescent activators and other nonluminescent impuri-

ties included in the host lattice to an extent dependent on the concentration of each and the facility, determined by the capture cross section, with which each one captures this energy. The concentrations and cross sections that lead to the capture of the greatest fraction of incident energy by radiative activators result in the phosphor of highest efficiency.

All the parameters considered above can be correlated with experimental results or with the physical properties of the phosphor constituents.

## The Effect of Large Cortical Lesions on Learned Behavior in Monkeys

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The behavior of 4 normal monkeys and 8 monkeys with large cortical lesions was studied over a period of 5 years. The operated monkeys were first subjected to large unilateral lesions, with sparing of the motor and first somatic areas. Subsequently, these animals were divided into two groups, one with large lesions in the frontal association areas and the other with large lesions in the posterior association areas. An evaluation of the differential effects of these two bilateral lesions is the primary concern of this paper.

The animals with large bilateral lesions of the frontal areas showed severe loss when tested on delayed reaction tests, although complete loss of this function was not demonstrated in any subject. Little or no loss was found on a series of tests of visual discrimination learning. The subjects with large lesions in the posterior association areas showed severe deficit on all of a series of tests of visual discrimination but showed little or no loss on delayed-response performances. Both groups of operated monkeys were inferior to the normal animals on the oddity problem, a complex learning test.

The findings indicate that delayed reaction behavior and visual discrimination behavior have foci and gradients of representation in different cortical areas. The quantitative nature of the deficits suggests that these intellectual functions are not represented exclusively in the frontal or posterior association areas. The extreme persistence of the deficits implies a stability of representation for these cortical areas that argues against recovery by vicarious functioning.

## An Absolute Theory of Solid-State Luminescence

Ferd E. Williams, *General Electric Research Laboratory*

Previous interpretations of solid-state luminescent phenomena have been qualitative or phenomenological. The quantitative calculation from first principles of the properties of a simple phosphor would be a significant theoretical advance. This has been accomplished for the absorption and emission spectra of thallium-activated potassium chloride.

It is first recognized that the luminescence of this phosphor is confined to transitions within the monovalent thallium ion and that the bonding of the crystal is largely ionic. After calculating the radial charge densities of the free thallium ion in the ground and excited states by the Hartree self-consistent field method for the outershell electrons, and the Fermi-Thomas method for the core, the polarizabilities, ionic radii, and compressibilities of these ions are deduced. The thallium ion in its various electronic states is substituted in dilute concentration for the potassium in potassium chloride, and the change in total energy of the system is calculated as a function of the thallium nearest chlorine ion distance, with the condition that the remainder of the lattice rearranges to minimize the total energy. Madelung, exchange repulsion, van der Waals, polarization, and coulomb overlap interactions are included. The absorption spectrum is then computed by recognizing that the various atomic configurations of the system in the ground state have probabilities in accord with a Boltzmann function, and that the probability of a particular transition energy is determined by the probability of the configuration that results in that transition energy. The emission spectrum is similarly determined from a Boltzmann distribution of configurations characteristic of the excited state.

The absorption and emission spectra are computed at various temperatures, and the peak positions and half-widths are found to be in satisfactory agreement with experiment. In addition, new insight is obtained on the detailed mechanism of solid-state luminescence.

## Recent Contributions to New York Archeology

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In 1944, on the basis of much previous field and laboratory research, the writer published a sequence, description, and analysis of the earlier aboriginal cultures of New York State. This covered 13 different cultural groups, all preceding the Iroquois in time, as known from excavations on some 70 Indian habitation and burial sites in the New York area (including Pennsylvania, New Jersey, New England, and lower Ontario). Continued work in this area on another series of sites by the writer and others since 1944 has amply confirmed the sequence of occupations and, furthermore, has contributed greatly to an understanding of the fine relationships and continuities among certain cultures. This has largely been achieved by the first systematic analysis of pottery typology for the area.

One of the results of this study has been a new hypothesis concerning the origin of Iroquois culture, previously derived by migration from an ultimate Ohio Valley source. It now seems more probable that the most recent cultures, ascribed to Iroquoian-speaking tribes, developed in large part out of previous cultures in the same area.

The more detailed picture of prehistoric events in New

York State, and the eastern United States in general, emerging from the aforementioned researches, has very recently been given a sounder chronological perspective through the radioactive carbon studies of Libby and Arnold, of the University of Chicago. The dates they

have derived from charcoal samples, taken from hearths on archaic period sites in New York during the course of our excavations, indicate an antiquity for the earliest occupation of more than 5,000 years of elapsed time. Other equally startling dates have been obtained.

[To be concluded October 20, 1950]

## Technical Papers

### Effectiveness of Cortisone Administered Orally<sup>1</sup>

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Since the report by Hench and his associates (1) that cortisone (Kendall's Compound E) has great antirheumatic properties, much research has been conducted to learn (1) how this hormone effects its results, and (2) how cortisone might be used with the greatest practical value as a therapeutic agent. In the latter category there have been studies to determine whether cortisone is effective when administered in ways other than intramuscularly, as it was used originally. Scarcity of the hormone has limited research but recently, through the kindness of its medical director, James Carlisle, Merck & Co., Inc., has supplied us with a small quantity of tablets (each 100 mg) of cortisone for clinical trial.

This preparation of cortisone has been tested in 4 patients with rheumatoid arthritis. The dose commonly employed for intramuscular injection was used orally, namely, 300 mg the first day, 200 mg the second, and 100 mg daily thereafter. In 2 patients the dose was increased to 200 mg daily, following a few days of 100-mg dosage.

In all patients cortisone taken in tablet form effected improvement in the rheumatic disease. In 2 patients cortisone tablets were given for only 10 days; the patients improved significantly from the 2nd day of treatment and relapsed promptly after cessation of the drug. The 3rd and 4th patients received tablets of cortisone for longer periods, 20 and 19 days, respectively. In each of these patients there was excellent clinical effect; the arthritic condition improved promptly and progressively, erythrocyte sedimentation rate was reduced to nearly normal, and general systemic improvement was gratifying. The 3rd patient previously had received cortisone intra-

muscularly during 2 periods of 23 and 20 days, and ACTH for 1 period of 14 days. In all respects the clinical effects of orally administered cortisone were comparable to those of this hormone given parenterally, and to ACTH. The 4th patient had prompt improvement during the first 3 days that cortisone was administered orally, then worsened somewhat. Consequently, the dose was increased to 100 mg twice daily and was continued at this level for the last 11 days it was administered. With the larger dose, improvement again progressed until there was nearly complete clinical arrestment of the arthritis. Subsequently, when this patient received cortisone intramuscularly in dosage similar to that employed orally, clinical response was comparable to that effected by cortisone taken orally. Both the 3rd and 4th patients volunteered preference for the tablets, because they considered the effects to be smoother than when the hormone was injected.

These observations clearly indicate that cortisone is effective when administered orally. This knowledge is indeed gratifying, especially in anticipation of practical therapy, for in patients with a chronic illness, such as rheumatoid arthritis, prolonged use of any drug should be facilitated by an effective oral preparation. At the same time abuse of tablets of such a potent hormone must be avoided.

Further studies of oral use of cortisone will be conducted as soon as supplies will allow.

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### Cytological Changes in Human Hypophyses after Cortisone and ACTH Treatment

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Following injections of cortisone in patients with various diseases, microscopical changes have been noted in the anterior hypophyses at post-mortem examination. The relevant data concerning age, principal disease, total

<sup>1</sup> These studies were made possible by generous grants from the Masonic Foundation for Medical Research and Human Welfare, and the Fund for Research in Rheumatic Diseases. Hospital for Special Surgery.



TABLE 1  
SUMMARY OF 8 AUTOPSED CASES TREATED WITH CORTISONE AND ACTH

Autopsy No.	Age, years	Principal disease	Total dosage		Total dosage	
			Cortisone, mg	No. days treated	ACTH, mg	No. days treated
Case 1, OE-48	42	Periarthritis nodosa	None	..	150	3
" 2, OE-106*	3	Leukemia, acute	2,950	28	None	..
" 3, OE-110*	2	" "	1,050	5½	"	..
" 4, OE-132*	3	Reticular cell sarcoma	1,150	7	"	..
" 5, OE-152*	4	Leukemia, acute	2,550	15	"	..
" 6, OE-159	11	" "	7,350	35	175	3
" 7, OE-182	4	" "	1,450	7	100	2
" 8, 50R-319*	28	Lupus erythematosus	1,500	8	None	..

\* Indicates presence of basophilic changes in anterior hypophysis.

dosage, and duration of treatment are summarized in Table 1.

The hypophyses were fixed in 10% formalin for 1 hr, dissected free of dura and weighed on a torsion balance. The weights are not analyzed here because of frequent leukemic infiltrations in that gland. Slices were then cut, and the tissues fixed in Zenker-formalin solution for 24 hr. Following washing and treatment in Müller's fluid, the tissues were dehydrated and embedded in paraffin. Sections were cut at 5  $\mu$ . They were stained with aniline acid fuchsin and light green and in some instances with azocarmine. Details of the staining procedure used by us are being published elsewhere (8).

The changes involved the basophiles, in which replacement of the basophilic granules by lumpy masses of hyaline basophilic material was noted. The alteration was noted usually in parts of the cytoplasm only, although scattered cells showed nearly complete ring formation at the periphery of the cytoplasm. The changes were most marked and advanced in case No. 8. They

were seen as early as 5½ days after onset of treatment. No definite changes of this type were seen in two cases, Nos. 6 and 7. In these two cases, courses of cortisone treatment were followed by injections of ACTH. The changes were inconclusive in case No. 1, in which the interval between death and autopsy was longer than 6 hours.

The morphological alterations were comparable to those described by Crooke (1) in the hypophyseal basophiles in Cushing's disease and related conditions. In addition to the hyalinization of the cytoplasmic granules, the nuclei were more centrally placed in our cases and were surrounded frequently by a paler zone of cytoplasm in which distinct basophilic granules were noted.

A detailed discussion of the possible significance of these changes will be presented in an article to appear in the near future.

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## On the Pigments of *Allescheria boydii*

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*Allescheria boydii*, a pathogenic fungus, produces a pigmented culture when grown in a basal medium of known chemical composition containing biotin. As first shown by Cury (1), this mold is unable to grow when biotin is omitted from the medium, the growth being proportional to the amount of biotin added (1, 2).

The pigment appears after 7-10 days of incubation at room temperature when the amount of biotin is higher than 0.0005  $\mu$ g/10 ml of medium. The appearance of the mycelium varies from reddish to violet or purple. The culture filtrates were golden yellow, varying somewhat in intensity. This yellow pigment proved to be different from the pigment from the mycelium.

The production of both pigments is conditioned by the pH of the medium. Pigmented cultures developed only in the range of pH between 4.0 and 6.8. Above pH 7.0

the mycelium was gray or white, and no pigment could be detected. It has been observed that under suitable conditions the pigments developed in the dark, as well as in the diffuse light of the laboratory.

The powdered mycelium was extracted with ethanol containing 2% hydrochloric acid, and a deep-red extract was obtained. This solution, when concentrated in vacuum, filtered, and left in the icebox overnight, yielded crystalline orange needles, with an mp of 131° C (Fig. 1). Better crystallization was obtained by the addition of a little dioxane.

The rough material was also purified by chromatographic adsorption with  $Al_2O_3$ . The pigment, dissolved in ethanol and strongly acidified, is easily extracted with chloroform; the red chloroform-extract showed an absorption maximum at 520  $m\mu$  (Fig. 2). The yellow pigment from the culture filtrates presented an absorption in the ultraviolet at 360  $m\mu$ . These determinations were performed in a Beckman quartz spectrophotometer.

The pigment from the mycelium is red at pH 1.0-2.0, orange at pH 2.2, changing to yellow at pH 7.8 and violet at pH 10.0. This pigment is insoluble in petroleum ether and in water, and soluble in ethanol and methanol





FIG. 1. Crystalline pigment obtained from the mycelium of *A. boydii* (polarized light).

in acid solution, and in chloroform and benzol in very strong acid solution. Aqueous alkaline solution dissolved the pigment, producing a violet precipitate. The yellow pigment of the medium is not soluble in organic solvents.

The reactions presented by both pigments are shown in Table 1.

The reactions presented by the mycelial pigment show that it belongs to the group of quinone pigments. A

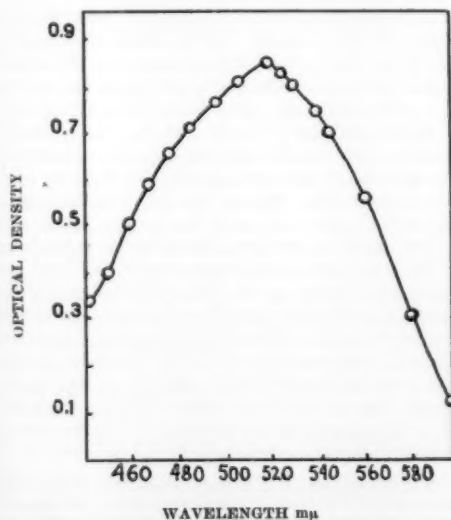


FIG. 2. Absorption spectrum of the mycelial pigment of *A. boydii* dissolved in chloroform. Data obtained with a solution containing 2 mg/ml, the thickness of the absorption cell being 1 cm.

TABLE 1

Reagents	Mycelial pigment	Pigment of the medium
Acetic acid	Red with green fluorescence	Not changed
Sulfuric acid	Blue-violet	Reddish
Ethanol-ammonia	Purple	Not changed
Acetic anhydride	Deep-red	Not changed
FeCl <sub>3</sub>	Olive-green	Brown-red
Bromine	Yellow	Orange-yellow
Acetic anhydride + H <sub>2</sub> SO <sub>4</sub>	Brown-red, forming a gelatinous precipitate	Not changed
Zn + NaOH	Color discharged	Color discharged
Br + NaOH	Color discharged	Color discharged

more detailed study of the conditions in which this pigment is produced, as well as its chemical composition, is in progress.

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## The Coloration of the Tail Tip of Young Fer-de-Lances: Sexual Dimorphism rather than Adaptive Coloration

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An interesting example illustrating the complexity of adaptive coloration in animals recently came to our attention with the birth of a brood of fer-de-lances (*Bothrops atrox*). In some individuals of this brood, as is typical for this species and for other pit vipers of the family Crotalidae, the last inch or so of the tail is a brilliant sulfur yellow, except for the very tip, which is dark. The general appearance is that of a yellow worm with a black head. In a number of instances recorded in the literature, which we shall cite, captive individuals have been observed to set the tail twisting and writhing when food is offered. Various authors have suggested that in these forms the tail tip serves as a lure attracting lizards, frogs, or toads to within striking distance of the snake.

The first mention of this adaptation seems to be that of Ditmars (4), who described the color of the tail and the tail wiggling behavior of the copperhead (*Agkistrodon contortrix*) and suggested its possible value in luring frogs. Henry (5) actually observed young of the hump-nosed pit viper (*A. hypnale*) attract small lizards in this manner and kill and eat them. According to Pyecraft (3), the same manner of tail wiggling is exhibited by juveniles of the copperhead, the cottonmouth (*A. piscivorus*), and the fer-de-lance. Additional observations substantiating the idea that the bright tail serves as a lure are reported by Neil (2) for the copperhead, and

by Allen (1) for the Mexican moccasin (*A. bilineatus*). The latter account includes an excellent photograph of the typical tail lure position of young Mexican moccasins and in addition observations of frogs struck and eaten after having been attracted to the wiggling tail tips. Cott (5) briefly discusses the bright tail tip in these pit vipers among those characters which lure prey to the most dangerous part of their enemy.

Actually successful luring of prey by the use of the tail has thus been observed only in two species, *A. hypnale* and *A. bilineatus*. There are, however, strong indications that the same phenomenon occurs in the two North American moccasins, *A. contortrix* and *A. piscivorus*.

The situation is even less well known in the neotropical pit vipers of the genus *Bothrops*. An excellent opportunity presented itself on September 27, 1949, when a fer-de-lance from the state of Veracruz, Mexico, gave birth, as mentioned, to 20 young in the laboratory. In this litter there was marked sexual dimorphism in the color of the tail tip. Only in males was the tail tip a uniform brilliant yellow. In females the terminal third of the tail was only slightly lighter than the rest of the tail (see Fig. 1). Of the eight females one had a dull yellow tail tip, but even in this individual, dark dorsal blotches were clearly discernible on the tail down to the very tip. If the tail tip of young fer-de-lances serves to attract prey, as Pyecraft (9) suggests, why should the

tail of one sex show the color adaptation while that of the other does not? Apparently here is a sexual character which, oddly enough, disappears before maturity.

It has been called to our attention that the occurrence of such a sexual difference in a single litter could be due to a simple sex-linked recessive character. Sex determination in *Bothrops atrox* is probably of the XX-XY type, with the female exhibiting the heterogamety.<sup>1</sup> If such is the case and the dark tail tip is due to a simple sex-linked recessive character ( $x$ ), the yellow tail tip being due to its dominant allele ( $X$ ), mating of an  $xx$  male with an  $Xy$  female would result in a brood of yellow-tailed males ( $Xx$ ) and dark-tailed females ( $xy$ ).

Preserved young from two other litters were available for study. The males all had yellow tail tips and the females all dark tail tips. This is in contrast to the situation in *A. contortrix* and *Bothrops nummifer*, in all of which the young of both sexes have bright yellow tail tips. Data concerning these specimens are given in Table 1.

It seems highly unlikely that three randomly selected broods of fer-de-lances would all have the specific parentage required for the situation described. If the genetic explanation as given were the correct one, the parental genotypes necessary to give the recorded litters are only one assortment of the six possibilities. Assuming that the genes in question are present in equal frequencies in natural populations, the probability that the specific mating necessary to give the recorded broods would occur three times in succession is less than 0.5 out of 100. Preponderance of one or the other of the genes would further reduce the probability. Our original premise that the difference in tail color is a case of sexual dimorphism seems to be the simplest explanation.

The feeding habits of the young fer-de-lances were observed with great interest. In the beginning several of them were kept with a litter of young timber rattlers (*Crotalus horridus*), all of which were almost twice as large. Three times the young fer-de-lances attempted to eat rattlesnakes, but in each case the victim, though overcome, could not be swallowed by their smaller assailants. Small frogs (*Aoris gryllus* and *Hyla crucifer*) were eaten readily. Though the tail was held up at times and though in the dark the tail tip of the male was very much in evidence, there was no well-marked tail wiggling such as described in the *Agkistrodon*. If the tail were of any use in luring the frogs it was not evident to us. Several days later a young female fer-de-lance tried to eat a slightly larger male but could not swallow it. The next day the same female ate a Dekay's snake (*Storeria dekayi*). This variation in diet, including prey not attracted to wormlike lures, could conceivably be associated with the failure of the bright tail to develop in both sexes.

<sup>1</sup> All of the reptiles which have been carefully studied have shown the XX-XY type of sex determination with heterogamety in the female. Evidence is presented by Nakamura (7) that such is the case in two species of the genus *Trimacrus*. The latter genus and *Bothrops* are so closely related that some authors consider them as one and the same genus.



FIG. 1. Four-week-old fer-de-lances of both sexes, showing the bright yellow tail of the male (at the bottom). Photo by Charles L. Scott.

TABLE 1  
COLOR OF TAIL TIP OF JUVENILE PIT VIPERS

Source of specimens*	Yellow	Dark	Total
<i>Bothrops atrox</i>			
Tehuacan, Veracruz, Mexico	♂ 12	♂ 0	
(UIMNH) .....	♀ 0	♀ 8	20
Guatemala (CAS)† .....	♂ 2	♂ 0	
.....	♀ 0	♀ 3	5
Port Utria, Colombia (USNM) ..	♂ 13	♂ 0	
.....	♀ 0	♀ 13	26
<i>Bothrops nummifer</i>			
Portillo Grande, Yoro, Honduras	♂ 13	♂ 0	
(CNHM)‡ .....	♀ 17	♀ 0	30
Rio Indio headwaters, Panama	♂ 8	♂ 0	
(ANSP) .....	♀ 7	♀ 0	15
Puehlo, Nuevo Honduras (UMMZ)	♂ 3	♂ 0	
.....	♀ 1	♀ 0	4
Orizaba, Veracruz, Mexico	♂ 2	♂ 0	
(USNM) .....	♀ 2	♀ 0	4
<i>Akistrodon sutoria</i>			
Eleven miles northwest of Frederick, Frederick County, Maryland (UIMNH) .....	♂ 3	♂ 0	
.....	♀ 2	♀ 0	5
Two and a half miles east of Lamb, Hardin County, Illinois (INHS) .....	♂ 6	♂ 0	
.....	♀ 4	♀ 0	10
Three miles north of Valmeyer, Monroe County, Illinois (INHS)† .....	♂ 2	♂ 0	
.....	♀ 0	♀ 0	2
Three miles north of Edinham, Edinham County, Illinois (INHS) .....	♂ 2	♂ 0	
.....	♀ 3	♀ 0	5

\* The following abbreviations are used for the institutions from which specimens were examined: ANSP, Academy of Natural Science of Philadelphia; CAS, Chicago Academy of Sciences; CNHM, Chicago Natural History Museum; INHS, Illinois Natural History Survey; UIMNH, University of Illinois Museum of Natural History; UMMZ, University of Michigan Museum of Zoology; USNM, U. S. National Museum.

† Probably not the complete litter.

‡ Mixture of several litters.

The scanty information available concerning the food of the several juvenile akistrodons with bright tail tips in both sexes suggests a preference for frogs and small lizards. To illustrate, using information pertaining to one of the better-known forms, Chenoweth (2) writes that a litter of young copperheads ate cricket frogs (*Acris gryllus*) and a single anole (*Anolis carolinensis*), but steadfastly refused baby mice. That the latter is not always strictly the case is obvious from Gloyd's (5) statement that "At ages of two to three weeks some of the young fed upon small mice." The jumping viper, *Bothrops nummifer*, which has a bright tail in young of both sexes, may not fit into this scheme, as the only known food items of juveniles are crickets and grasshoppers. However, in none of these instances is the food of juveniles under natural conditions definitely known.

It would be very presumptuous to base definite conclusions on such scanty information. The data available do suggest that:

1. Pit vipers of which the young may depend on prey attracted to worms have bright-colored, wormlike tail tips in both sexes and exhibit the typical tail wiggling activity.

2. In those in which the young in one or both sexes lack the yellow tail tip, and exhibit no typical tail wiggling behavior, the food may be more generalized.

Although these generalizations are far from confirmed, they should be called to the attention of persons having the opportunity to gather pertinent information.

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## Molybdenum Deficiency in Dunkirk Silty Clay Loam

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In 1939 Arnon and Stout (2), using culture solutions, obtained evidence that molybdenum is an essential element. Molybdenum deficiencies in crop plants grown on soils in Australia, New Zealand, and Europe have been reported, but the writer knows of no similar deficiency in the Americas except in serpentine barren soils of California (5). Response to molybdenum was also obtained in New Jersey in pots in the greenhouse as a result of dipping seed pieces of potatoes in dilute solutions of molybdenum (1). Davies and Mitchell (3, 4) did pioneer work on molybdenum deficiency in cauliflower. The latter noted marked differences in varietal susceptibility to whiptail. Wessels (7) had previously noted varietal differences on acid soils on Long Island, New York. He did not get symptoms of whiptail when a susceptible variety was grown on similar acid soils in the greenhouse. For the Long Island soils used, he found that the range of soil reaction for maximum cauliflower production was between pH 5.5 and 6.6. Yellowing and whiptail were found in soils below pH 5.5.

On October 8, 1949, the writer observed a cauliflower strain: trial conducted by Paul Work and George Elle near Ithaca on Dunkirk silty clay loam, a productive and extensive soil type. Replications on the higher part of the plot showed marked whiptail in varieties of the Super Snowball type and practically none on strains of Improved Holland Erfurt (Snowdrift). A weather station located within one mile of the plot indicated a deficiency of 2.68 in. of rainfall (departure from normal) for the months of June through October. A considerable part of one rain of 2.43 in. on August 29 probably ran off the higher part

of the plot. Soil was obtained to plow depth from the area of maximum whiptail and placed in  $\frac{1}{2}$ -barrel steel drums that had previously been painted with a nontoxic asphalt varnish. These large containers were used in an attempt to avoid frequent watering, which it was felt might have been responsible for the failure of Wessels' greenhouse plants to show whiptail, as they did in the field.

The soil was allowed to dry in the drums until February 8, 1950. On February 9, 2 cauliflower plants of a strain of Super Snowball, seeded December 6, spotted into similar soil December 22, and grown under fluorescent lights, were planted in each container and fertilized with a small amount of  $\text{KNO}_3$ . On February 24, reagent grade  $\text{KH}_2\text{PO}_4$  in solution to supply 500 lb to the acre and borax to give 10 lb to the acre were added in trenches  $2\frac{1}{2}$  in. deep and 4 in. from the plants. Six of the drums were supplied with ammonium molybdate at the rate of 1 lb to the acre in the trenches, and 4 received no molybdenum. Additional drums could not be placed in the greenhouse space available.  $\text{KNO}_3$  at the rate of 200 lb to the acre was added, and the soil watered. On February 27, the soil in all drums was thoroughly wet, and 5 of the drums were covered with wet burlap bags that dipped into water in jars beside the drums. The bags covered practically all the soil in the drums but did not touch the plants or the soil. The wet bags reduced water loss from the soil, and these drums were not watered during the course of the experiment. The other 6 drums were watered heavily, but not leached, whenever the soil became dry.

The plants in all the drums turned somewhat yellow following the heavy watering prior to and including that of February 27. On March 17, it was noted that those in both series receiving molybdenum were greener than those without molybdenum. Differences in growth and color became more marked daily and were very marked on March 29, when the experiment was terminated because the plants in the dry soil were wilting slightly during the warm part of the day. All the plants lacking molybdenum showed marked interveinal chlorosis, as noted by Davies and Waring and Wilson and Shirow (3, 6). Growth was very upright, and the leaf tissue appeared brittle. A few of the smaller leaves showed parts of the laminae greatly reduced, suggesting a condition similar to whiptail. A few leaves had dead tissue at the edges. All plants supplied with molybdenum were of dark-green color and growing normally. The average weight of the plants cut off at the soil surface from soils with molybdenum was 429.5 g; the weight of those not supplied with molybdenum was 310.7 g. There was little difference between plants in the two moisture treatments. It is probable that the plants not supplied with molybdenum obtained some molybdenum from the drums in spite of the coating of varnish. The pH at the end of the experiment was 4.60.

C. B. Raymond, after seeing the marked response of the cauliflower to molybdenum, stated that on June 1, 1948, he had noted areas of very poor growth in red clover seeded for a cover crop in the same field. He made a map of the field and obtained pH readings. Areas

with good clover averaged pH 5.40, whereas those with poor clover averaged pH 4.90. A check with Raymond's map disclosed that the soil for this cauliflower experiment was obtained in the center of one of the largest areas that showed poor clover growth in 1948. Much of the literature on molybdenum deficiency indicates that clovers are especially susceptible.

Experiments on this plot with cauliflower plants from the same seed lot as used in the greenhouse show a marked response to molybdenum. On August 1, 1950, it was evident that practically all the plants not supplied with molybdenum would be so badly whiptailed as to produce no marketable cauliflower.

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## A Simple Apparatus for Producing Droplets of Uniform Size from Small Volumes of Liquids

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Frequently in the study of sprays of plant-growth regulators, fungicides, and insecticides it is pertinent to observe the behavior of droplets on the vegetation. For a long time it has been observed that foliage is wetted more readily by aqueous sprays containing certain surface-active agents and by oils than by wholly aqueous sprays. Moreover, the leaves of different species vary in their ability to retain droplets of various kinds of liquids. Conventional spray equipment is unsuitable for studying the action of individual droplets impinging on the leaves of different species. Likewise, the usual spray equipment is not satisfactory for applying low volumes of liquid (.01-.1 ml) as small individual droplets of uniform size to individual leaves or plants. By utilizing a principle devised by Lane (1) and Levvy (2) for producing small drops of liquid, a simple glass apparatus has been designed which produces in quantity individual droplets of uniform size and is adaptable for delivering very small volumes of aqueous and nonaqueous solutions. The apparatus has been termed a droplet sizer.

One end of a glass tube was drawn into a very fine capillary, and the tip was broken off at a point where its diameter was just small enough that water would not run through except under low pressure (Fig. 1); a tube 11 mm OD by 145 mm long had about 5 ml capacity. The outside diameter of the capillary tip, *B*, influences the range of droplet sizes that can be produced. Three holes, *G*, of

approximately 3 mm diameter were made in the liquid tube, *D*, near the air inlet, *F*, and then the tube was sealed into an air jacket (20 mm OD) having the shape of *E*. A larger glass tube may be used in making the liquid chamber if it is desirable to work with larger volumes of liquid. In the construction of the air jacket it is important that the constricted portion, *C*, be of sufficient length to insure a smooth flow of air, which picks off the droplets formed on the capillary tip as they reach the desired size. A constricted portion about 1½ in. long and 2.5–3 mm ID was adequate to produce uniform droplets that could be directed on the desired surface area with accuracy. The protective rim, *A*, helps prevent accidental breakage of the capillary tip.

Liquid to be discharged can be placed into the fluid tube, *D*, with a pipette. If it is desired to discharge completely a measured volume of liquid of high surface tension, care should be exercised in introducing the pipette to prevent adherence of separate droplets to the fluid tube wall. All liquids should be free of solid particles or lint because the small capillary can be easily blocked.

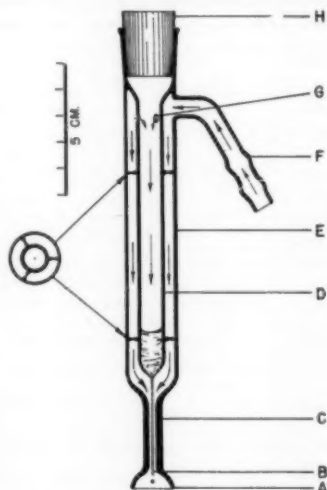


FIG. 1. Glass droplet sizer.

If the capillary becomes blocked, the foreign material may sometimes be removed by inserting a tightly fitting rubber tube to a level below the holes in the liquid tube and applying negative pressure by attaching the other end of the rubber tube to a laboratory suction pump. When not in use the apparatus should be stored upright in a covered vessel containing enough ethyl alcohol to cover the capillary tip.

Filtered air is introduced at *F*; pressure is measured manometrically. The pressure is adjusted to give a steady formation and removal of uniform droplets from tip *B*. Both rate of production and size of droplets are governed by this single pressure adjustment. The pressure employed in certain studies ranged from 2 to 30 mm mercury at *F*, depending upon the character of the liquid

and the size of the fine capillary. Liquids with a high surface tension may not flow readily at first because of the presence of small air bubbles near the end of the capillary. Initially, to remove these small air bubbles, a higher pressure may be required; once they are eliminated, the pressure can be quickly readjusted to the desired level. If the air pressure is too great, extremely small droplets of mixed sizes are produced. Typical droplet patterns obtained with the droplet sizers are shown in Fig. 2. With different droplet sizers, aqueous droplets

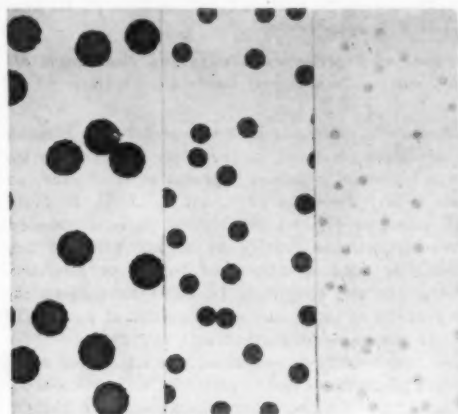


FIG. 2. Typical droplet patterns.  $\times 1$ .

ranging from .22 to 1.82 mm in diameter have been produced. It has been found that with the same liquid used in the same apparatus droplet size is reproducible at the same pressure.

Data obtained with one droplet sizer indicate that within limits the diameter of the droplets produced is inversely but not linearly proportional to the air pressure (Table 1). It has been found that change in liquid

TABLE 1  
DIAMETER OF AQUEOUS DROPS PRODUCED AT DIFFERENT  
AIR PRESSURES. OUTSIDE DIAMETER OF  
CAPILLARY TIP WAS .22 MM

Air pressure, mm Hg	Diameter drops, mm
4	1.40
9	0.72
12	0.54
23	0.45
28	0.40

level in the inner tube affects the size of the droplets to a slight extent. If greater accuracy is required, variation in droplet size can be avoided by maintaining a constant level of liquid. This may be done by replenishing the supply with a syringe inserted through stopper *H*.

The apparatus has been found satisfactory for delivering known small volumes of liquid as uniform droplets without calibration of delivery rate. The system may also be calibrated if required for a particular purpose.



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## Preparation of Nonprotein Fractions Possessing Adrenocorticotrophic Activity from Fresh Sheep Pituitary Glands<sup>1</sup>

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Frequently references have appeared in the literature to substances possessing adrenocorticotrophic activity that are not protein in nature. Anselmino, Hoffmann, and Herold (1), Tyslowitz (11), and C. J. O. R. Morris and colleagues (2, 3) have obtained material possessing adrenocorticotrophic activity by ultrafiltration of acid, neutral, or alkaline extracts of hog or ox pituitaries. Recently Li and co-workers (4, 5, 7) have found that the products of peptic and acid digestion of pure ACTH protein possess adrenocorticotrophic activity.

We have recently demonstrated that some sheep ACTH protein preparations can be extracted with trichloroacetic acid, with the resulting supernatants possessing increased amounts of activity per unit of nitrogen. These preparations may be dialyzed at certain pH's, and the activity is shown to pass through the dialysis membrane (3).

The preparation, from sheep pituitary glands, of non-protein fractions possessing adrenocorticotrophic activity has been undertaken in the hope that good amounts of activity may be so obtained. Five percent trichloroacetic acid (TCA) was used as the solvent. In a typical experiment, 250 g of fresh sheep pituitary glands were ground in the cold (5° C) with 175 ml of water. To this mixture 375 ml of 10% TCA was added, and the resulting mixture was stirred for 4 hr in the cold, and then allowed to settle out overnight. The precipitate was removed by centrifugation in the cold, and discarded. The TCA supernatant so obtained was extracted 10 times with 200 ml aliquots of diethyl ether in order to remove the TCA. The solution was then lyophilized, and 2.9 g dry weight of a brownish, hygroscopic powder were obtained. Kjeldahl analyses revealed the powder to contain 10% nitrogen, of which about 10% was ammonia and amide nitrogen, and 43% was amino nitrogen. When an aliquot of the powder was subjected to 2-dimensional paper chromatography in phenol-water followed by lutidine-water (1:1), and the paper then sprayed with ninhydrin, it was found that its free amino acid pattern was similar to the patterns obtained from the hydrolysis

of casein. In addition, several spots undoubtedly due to other components (peptides?) were obtained.

The powders were then subjected to assay for adrenocorticotrophic activity by the ascorbic acid method of Sayers *et al.* (9) and by the repair test of Simpson *et al.* (10), and were shown to be active. By the ascorbic acid depletion method, a response equivalent to 10  $\gamma$  of an ACTH protein isolated by Li was obtained from the injection of 0.5 ml/100 g body weight of a solution containing 0.65 mg of the powder per ml. Thus an activity equivalent to 360 mg of an ACTH protein could be obtained from 1 kg of fresh sheep glands.<sup>4</sup>

Previous experiments have shown that peptic hydrolyzates of ACTH, consisting of polypeptides, when chromatographed on paper using phenol-water as solvent, yield among others a fluorescent area, with an  $R_f$  value of 0.95, which when eluted and assayed showed considerable adrenal-stimulating activity, whereas the rest of the paper was almost devoid of activity (6). This was demonstrated, too, with whole ACTH protein (3). TCA supernatants of whole sheep pituitaries, when chromatographed as above, presented a similar fluorescent area at the front (Fig. 1), which, when eluted, was shown



FIG. 1. Ascending chromatogram of 2 mg of the 5% TCA extract of fresh sheep pituitaries run in phenol-H<sub>2</sub>O and developed with a 0.2% solution of ninhydrin in ethanol.

to have considerable adrenocorticotrophic activity by the ascorbic acid test, whereas the rest of the paper contained minimal amounts of activity. In one such experiment a total of 28 mg of the powder was run on a series of papers, and the fluorescent areas were eluted, combined, and lyophilized, and then dissolved in 4 ml of water. The solution was assayed at a level of 0.5 ml/100 g body weight, and a maximal response was

<sup>4</sup> In order to demonstrate further the nonprotein nature of the active material, 200 mg of the TCA extract powder was dialyzed for 3 days in the cold through a Visking sausage casing. The dialysate was lyophilized, and the resulting powder was made up to a concentration of 34 mg of the original powder per ml of solution. When assayed at 0.5 ml level, it showed a maximum response.

<sup>1</sup> Aided by grants from the U. S. Public Health Service RG-409 (C-2).

<sup>2</sup> With the technical assistance of Betsey S. Williams.

<sup>3</sup> We should like to acknowledge the support of C. H. Li in our experimental work, and the advice of John H. Northrop, who was kind enough to read this paper.



obtained. In our hands a maximal response corresponds to about 50  $\gamma$  of our standard ACTH protein. Assuming, therefore, a minimum of an equivalent of 50  $\gamma$ /0.5 ml, the original 28 mg contained a minimum of 400  $\gamma$  of activity. Thus, a minimum of an activity equivalent to 170 mg of an ACTH protein can be obtained from 1 kg of fresh sheep glands.

It is of interest to note that the only other anterior pituitary hormone that could be demonstrated in these extracts was the follicle-stimulating hormone (FSH), which was apparently present in large quantity. However, it could be separated from the ACTH activity by dialysis, since the FSH did not pass through a dialysis membrane.

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## Simple Calibrator for Warburg Respirometers<sup>1</sup>

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The standard method of calibrating Warburg respirometers is to determine the volume by weighing with mercury. Less laborious methods have been devised, but most of them lack sufficient accuracy or simplicity. With the present simple calibrator a Warburg respirometer can be calibrated in a few minutes, accurately within 1%.

An accurately known volume of gas is withdrawn from the respirometer with a thermostabilized syringe device. The volume of the apparatus is calculated from the re-

sulting change in manometer reading. The principle is well known and was applied in the Münser-Neumann method (1).

The calibrator (Fig. 1) is essentially a syringe sur-

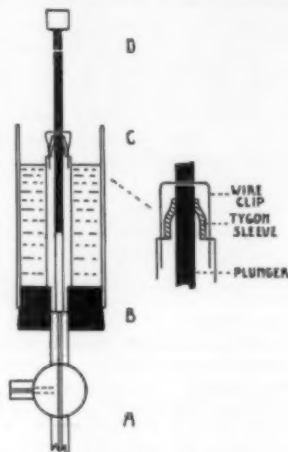


FIG. 1.

rounded by a water jacket. The metal or plastic barrel is about 5 cm long and is drilled and reamed for a  $\frac{1}{8}$ -in. drill rod, which serves as the plunger. The upper end of the barrel is provided with a short piece of tygon tubing, which provides an airtight seal for the plunger. A metal spring clip is fastened to the upper end of the barrel and presses lightly against the plunger. Two fine grooves (C and D) 3 cm apart are machined around the plunger. These serve to arrest the plunger accurately when they engage the metal clip. The apparatus is calibrated by measuring the diameter of the drill rod with a micrometer. The distance between the grooves is measured to within 0.1 mm. A slight film of grease travels with the plunger through the tygon seal, and adds to the volume displaced by the plunger. This amount was found to be negligible ( $< 0.1\%$ ) when a light grease such as vaseline was used. The volume extracted by our calibrator is 234 mm<sup>3</sup>, known to within  $\pm 0.2$  mm<sup>3</sup>.

The volume of gas determined by the present procedure includes not only the volume of the Warburg apparatus up to the lower opening of the stopcock (Fig. 1, A) but, in addition, all air spaces included between A and C.

The volume AB can be determined by filling it with water from a tuberculin syringe. This volume in 10 of our apparatus averaged 80 mm<sup>3</sup>. The gas volume B to C can be kept negligible by having a flat connection at B, and the plunger in the low position, ending flush with B.

Each Warburg vessel is charged with a volume of water from a tuberculin syringe equal to AB (in our case 80 mm<sup>3</sup>). The respirometers are placed in the water bath at room temperature, and the water jacket of the calibrator is filled with water from the water bath.

After a period of thermoequilibration, the calibrator is attached to the respirometer (Fig. 1). A small amount

<sup>1</sup> This work was supported in part by a grant from the William F. Milton Fund.

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<sup>3</sup> We wish to acknowledge the assistance given us by John Andrews, machinist.

of water or saliva applied to the joint *B* keeps the air in the calibrator moist. The Brodie solution is brought to the desired mark, and the gas pressure in the calibrator and the manometer is equilibrated to air. In case the apparatus does not have a three-way stopcock, the pressure can be equalized by pulling out the plug of the stopcock or by opening the side arm of the vessel.

The plunger is pulled out from the lower to the upper position, the manometer fluid is adjusted back to the mark, and the pressure is read. As a check, the plunger is pushed down again, and the procedure is repeated. If there is no leak the readings should agree to within less than 1 mm.

The gas volume of the respirometer is calculated according to the following formula:  $V(Pb - Pw) = (V + Vc)(Pb - Pw - h)$  which, solved for  $V$ , gives:  $V = Vc \left( \frac{Pb - Pw}{h} - 1 \right)$  where  $V$  = volume of the respirometer,  $Vc$  = volume withdrawn by the calibrator,  $Pb$  = barometric pressure,  $Pw$  = water vapor pressure, and  $h$  = change in pressure in the manometer. All pressures are expressed in mm of Brodie solution. For accurate calibrations it is recommended to check the specific gravity of the Brodie solution.

The present method was checked on 10 respirometers that had been accurately calibrated by mercury. The results of both methods agreed within 1%. Actually, 7 out of the 10 were within  $\pm 0.5\%$ .

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## Anodic Decalcification of Mineralized Tissue<sup>1,2</sup>

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A large part of our knowledge and understanding of the nature of such mineralized tissues as teeth and bone rests directly upon decalcification methods that involve various acid solutions. The solubility of a mineralized tissue, such as enamel, in different acids differs greatly and appears to depend upon factors other than pH alone (6).

This is a preliminary report of studies on methods and means for the anodic decalcification of such normal mineralized tissues as teeth, bone, eggshell, coral, mollusk shell, and such pathologic calcified tissues as osteomata and ectopic calcifications.

<sup>1</sup> Read before the Northwest Section, International Association for Dental Research, at the University of Washington, Seattle, May 8, 1949.

<sup>2</sup> This study was made possible by the financial support of the Oregon State Dental Society.

<sup>3</sup> Respectively, research assistant and professor and head of the Department of Anatomy and Histology, School of Dentistry, University of Oregon, Portland.

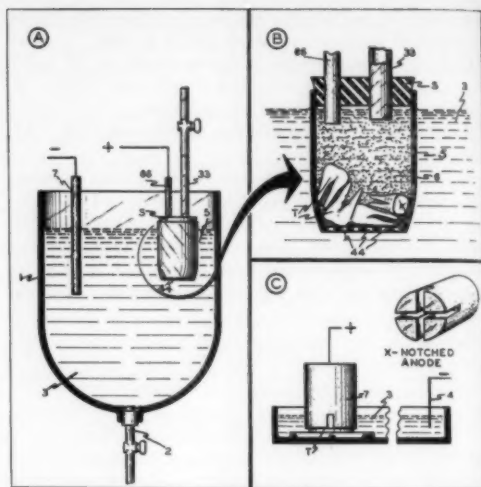


FIG. 1. Anodic decalcification apparatus, showing arrangement for gross specimens, *A*, and the tissue-anode assembly, *B*; thin-ground section apparatus, *C*.

The electrically forced migration of the mineral constituent of bone, with use of strong acid solutions, was first described by Richman *et al.* (8) and later by Friedland (4). These investigators relied upon the movement of  $Ca^{++}$  to a cathode—somewhat the reverse of electro-deposition, a “deplating” of the calcium phosphates and carbonates from the bone. Tests upon tooth organ material were apparently not undertaken in the earlier studies.

The anodic decalcification of hard tissue is contrary to the general belief that, for a substance to undergo anodic attack or anodic dissolution, it must be a conductor of electrical energy (5). Decalcification of tooth substance occurs despite the relatively great electrical resistances involved, which vary from  $6 \times 10^6$  ohms (3) downward for dry dentin to between  $17.5 \times 10^4$  and  $36 \times 10^6$  ohms for human enamel (1, 2). Moist dentin, however, is a conductor, showing values between  $84 \times 10^4$  and  $1.7 \times 10^6$  ohms (7). Factors modifying the electrical conductivity in tooth substances are the amount of moisture, degree and type of mineralization, available supply of soluble salts, and the conditions of the determination.

As might be expected, the nonmineral parts of the tooth appear to carry the current best, and most of the current seems to be conducted along the dentinal tubules. Our studies have indicated that, in customary acid decalcification of teeth, the enamel is most readily attacked, the dentin and cementum much less so; in anodic decalcification the opposite is usually observed.

**Gross specimens.** For the decalcification of whole teeth and masses of bone, the apparatus shown in Fig. 1 *A* and *B*, was developed: The teeth, *T*, are embedded in 10-20 mesh 50% ferrosilicon, within a sieved Gooch crucible, 5, provided with a 2-hole rubber stopper, 3. Through one hole of the stopper a hard carbon rod, 66,

is inserted, to make contact with the FeSi. Inserted through the other hole is a glass tube, 33, in communication with a supply of electrolyte, 3.

The FeSi-embedded tissue specimen is loosely packed into the sieved crucible (e.g., Coors No. 3), with space allowed at the top. This space facilitates free flow of the electrolyte through the system. The anode member, B, is suspended within a 4-liter open-neck bell jar, 1, supported in an inverted position. A cathode, 7, is also supported within the open jar, several cm from the anode assembly. The lower neck of the bell jar is fitted with a stopper and glass cock, 2, for regulating the level of the electrolyte and for draining the system.

An electrolyte is then placed in the bell jar, its level being brought within about 0.5 cm of the crucible edge. An additional supply of electrolyte is placed in a reservoir unit, situated above the main assembly, A, for gravity or gas-bubble feed through the anode crucible and out its sieved bottom, 44, into the bath.

With the apparatus shown in A and B of Fig. 1, the resistance is generally between 200 and 400 ohms, depending upon the nature and size of the specimen(s), the packing of the FeSi, the conductivity of the electrolyte, and the temperature. Between 100 and 400 ma is usually the current drawn by one such unit.

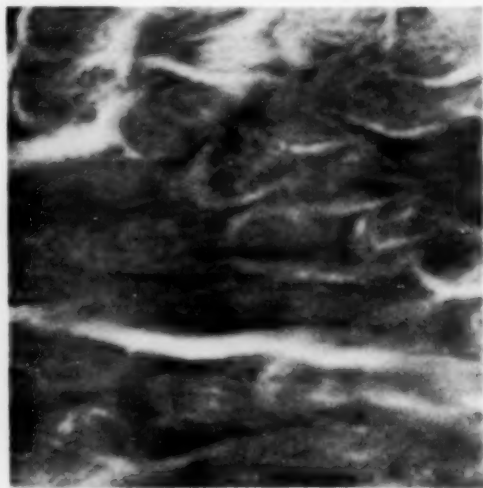


FIG. 2. Human tooth enamel anodically decalcified (2% NaCl; 30 hr), showing in transverse section the organic matrix (hematoxylin;  $\times 500$ ).

**Thin-ground specimens.** For the decalcification of thin-ground sections of teeth a relatively simple arrangement was developed (Fig. 1 C): The tissue section, T, is placed upon a plane microscope slide, within a Petri dish, in contact with either a lump of 50% FeSi or the end of a hard carbon rod, 7. When a carbon rod is employed, the contact end is preferably notched or slotted longitudinally, to permit escape of anodic oxygen; the same function is served by the irregular surface of the

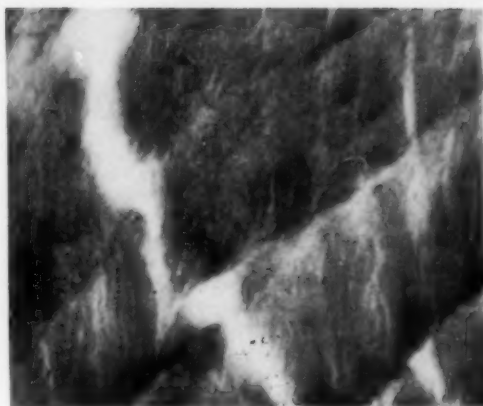


FIG. 3. Human tooth enamel anodically decalcified (2% NaCl; 30 hr), showing longitudinal view of the organic matrix replica of perikymata (hematoxylin;  $\times 390$ ).

FeSi. Complementing the tissue-anode assembly is a cathode, 4. An electrolyte, 3, is then added to cover the specimen. This system should draw approximately 20-60 ma, depending upon its size.

By means of anodic decalcification the rate of demineralization for a given electrolyte is accelerated. A wide choice of materials is available which otherwise do not qualify as decalcifying agents. Whole teeth may be decalcified in as little as 10-15 hr, as contrasted to the several weeks often required in nonelectric methods. Using 2% nitric acid (with or without such antioxidants as di-tert-butyl-p-cresol) or 5% lactic acid, the tooth matrices are obtained as firm yellow or white products, respectively. With alkali chlorides the mineral matter of teeth, bone, and eggshell is thrown into the bath as a white, flocculent precipitate which, in the case of teeth and bone, is accompanied by a yellowish or brownish oil-like material. Other compounds, such as sodium formate (3.3%), cause a green substance to appear in the roots of human teeth. The enamel cuticle and plaques are dislodged from the tooth surface and, in many instances, can be recovered intact as a cast of the crown. Metal sols may be formed, usually during the early stages of processing in electrolytes of low conductivity, and these are dispersed in the hard tissue; e.g., we have produced purple of Cassius in human tooth enamel. The anodic decalcification of thin-ground sections (Fig. 1 C) permits visual or photographic study of the sequence of changes that occur.

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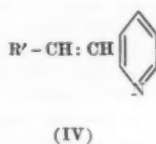
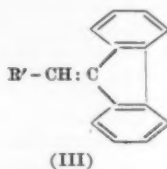
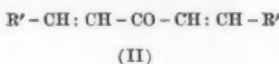
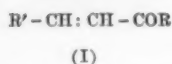
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## Reactions with 9-Anthraldehyde

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Foad I University, Abbassia-Cairo, Egypt

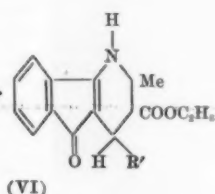
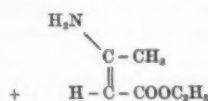
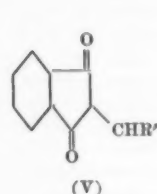
9-Anthraldehyde reacts readily with the reactive methylene group in malonic acid (I). A number of other condensation reactions have been studied, all leading to colored substances characterized by extended conjugated systems (5). With various methyl ketones, (9-anthrylidene)-compounds of the type (I) have been obtained.



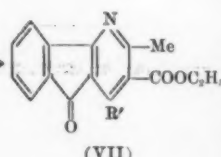
(R' = anthryl,  $C_{14}H_9$ )

9-Anthrylidene acetone (1, R =  $CH_3$ ), mp  $115^\circ$ , yellow crystals from alcohol (Found: C, 87.8; H, 5.6; M (micro-Rast), 236.  $C_{28}H_{18}O$  requires C, 87.8; H, 5.7%; M, 246), and di-9-anthrylidene-acetone (II), mp above  $250^\circ$  from xylene (Found: C, 91.1; H, 5.0; M (micro-Rast) 425.

9-Anthrylidene nitroaniline, of the type (VIII). 9-Anthrylidene-*p*-nitroaniline (VIII, R =  $p\text{-C}_6\text{H}_4\text{NO}_2$ ), orange-red crystals from alcohol, mp  $186^\circ$  (Found: C, 76.9; H, 4.2; N, 8.4.  $C_{28}H_{18}N_2O_2$  requires C, 77.3; H, 4.3; N, 8.6%), 9-anthrylidene-*m*-nitroaniline forms golden-



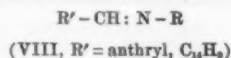
(R' = anthryl,  $C_{14}H_9$ )



$C_{28}H_{18}O$  requires C, 91.2; H, 5.1%; M, 434) are formed. Similarly, 9-anthraldehyde condenses with pinacolone, to give 9-anthrylidene-pinacolone (1, R =  $-C(CH_3)_3$ ). Fluorene gave 9-(9'-anthrylidene)-fluorene (III), yellow crystals, mp,  $230^\circ$  from xylene (Found: C, 94.8; H, 5.2.  $C_{28}H_{18}$  requires C, 94.9; H, 5.1%).  $\alpha$ -(9-Anthrylidene)- $\beta$ -(2'-pyridyl)-ethylene (IV), light-yellow crystals from petroleum ether (bp  $60^\circ\text{--}80^\circ$ ), mp  $106^\circ$  (Found: C, 89.3; H, 5.1; N, 4.7.  $C_{28}H_{18}N$  requires C, 89.7; H, 5.3; N, 5.0%) has been obtained either by the condensation of the aldehyde with  $\alpha$ -picoline or by the condensation of the aldehyde with  $\alpha$ -picoline methiodide (3), forming  $\alpha$ -(9-anthrylidene)- $\beta$ -(2'-pyridyl)-ethylene methiodide, followed by thermal decomposition.

9-Anthraldehyde also condenses with indane-1: 3-dione (4), by direct fusion of the two components to give 9-anthrylidene-indane-1: 3-dione (V), dark-red crystals, from xylene, mp  $228^\circ$  (Found: C, 85.7; H, 4.1, M (micro-Rast), 326.  $C_{28}H_{16}O_2$  requires C, 86.2; H, 4.2% M, 334).

yellow crystals from benzene, mp  $176^\circ$  (Found: C, 77.1; H, 4.2; N, 8.5.  $C_{28}H_{18}N_2O_2$  requires C, 77.3; H, 4.3; N, 8.6%), and 9-anthrylidene-*o*-nitroaniline forms yellow crystals from benzene, mp  $210^\circ$  (Found: C, 77.0; H, 4.1; N, 8.4.  $C_{28}H_{18}N_2O_2$  requires C, 77.3; H, 4.3; N, 8.6%).



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4. PETROW, V., SAPER, J., and STURGEON, B. *J. Chem. Soc.*, 1949, 2134.
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## Book Reviews

*The Yeast Cell, Its Genetics and Cytology.* Carl C. Lindegren. St. Louis, Mo.: Educational Publishers, 1949. 28 chapters. \$7.00.

This monograph of the personal researches of Lindegren and his co-workers includes much research and illustrative material that were published in one or more of Lindegren's numerous journal and review articles. Although it is useful to have this work collected, one does not thereby automatically obtain a clear, unbiased, comparative analysis of the veritable mass of investigation on the cytology of yeasts or of the recent surge of work on yeast genetics. This limitation of the book is evidenced by the fact that, of only 243 literature citations, 57 are to papers by Lindegren and co-workers; fewer than half the references are to papers on the cytology or genetics of yeasts. Much important recent work, including that of Lillian Nagel, who has attempted to correlate the main work on yeast cytology and to evaluate a variety of cytological techniques for use with yeasts, has been completely neglected.

The format of the volume is unusual. The pages (there are about 365) are not numbered consecutively but begin anew with each chapter and are indicated as 6-19, 21-5, etc. Numbering of tables and figures is handled in similar fashion. No index is provided, but there is an extensive table of contents. The book is not set from type but is a photo-offset reproduction from type-written copy. The quality of reproduction of the numerous photomicrographs is generally adequate. Use of arrows or pointers with these would have been helpful. Clerical errors are not infrequent and errors between text references and bibliographical citation are numerous. There are errors of one type or another in over 10 percent of the references. It proved impossible in most instances to associate Lindegren's own work as discussed in the text with any particular paper of his in the bibliography. A passing wave in the direction of the rear of the book was all that could be obtained from such statements as "I (1945)" when there proved to be four papers by Lindegren alone for that year, as well as two with other authors. For references to the work of other authors there was a generally free-and-easy attitude toward such matters as agreement between the year of publication as given in text and in citation, number of names in the authorship (the names might even be transposed), and spelling. References are not provided for figures and tables taken from Lindegren's own work.

The field of yeast cytology may be described as one that has been struggling along for the past 50 years in perpetual need of criteria for determining the nature (composition and function) of the numerous spots, globules, inclusions, and dancing bodies that are to be seen in yeasts. Names for these structures have been produced in abundance (one might say in superabundance

in view of the polemics that have raged among yeast cytologists). The author has been especially generous in contributing names for these tiny structures; in chapter 6 he lists nine terms by means of which he currently describes assorted globules, vacuoles, and stainable items. The word "currently" (meaning 1949) is employed designedly to characterize the transient use of terms for cytological entities. The text of a 1946 paper of his has been altered solely by the substitution of the word "mitochondria" for "fat deposits" in Tables 8-2 and 8-3; the 1946 reference for these tables described the "fat deposits" as being detected by microscopic observation of their refractile nature; no cytochemical procedures were employed for this characterization. We are thus indebted to Lindegren for a quick means of locating mitochondria in yeast cells. One merely observes a highly refractile object, labels it "fat deposit," and translates to read "mitochondria." This is not the only instance of word transformation to be found; the "balled-up chromosomes inside the nuclear vacuole" was the description accompanying Fig. 6-23 when it appeared in 1945; these "chromosomes" appeared following the application of Lugol's iodine solution. This simple "chromosome stain" now reveals the same bodies to be "nucleoli."

The author claims that by means of Refalko's modification of the Feulgen procedure (differing from others chiefly in the manner in which sulfite is provided for the dye reduction) "yeast chromosomes were successfully stained for the first time." This reaction has, in the hands of others, given a localization of color in a body which Lindegren terms the "centrosome" and which, he insists, divides by transverse fission, thus ruling out its being a "nucleus." He then detects an additional localization of Feulgen-positivity in minute structures which he equates with the "delicate suspending threads for the central volutin granule" in the historic picture of the yeast cell presented in 1910 by Wager and Peniston. In their highly imaginative drawing these threads are depicted as being 1/315 of the length of the longest axis of the cell; this would seem to indicate that the threads are about 0.02  $\mu$  thick. Possibly Dr. Lindegren could find more tangible structures with which to identify his "chromosomes."

Since the material on yeast genetics presented here is largely that already published by Lindegren and co-workers, it does not seem necessary to amplify the extensive critique of these papers published by Winge and Roberts in 1948. The fundamental discoveries of Lindegren and his school on the mating type and its inheritance and the inheritance of characters governing nutritional requirements and fermentative abilities are well known. The weak point in the Lindegren technique of hybridization is the lack of absolute certainty of the parentage of a



zygote. Proof of the parentage, in his technique, is supplied only by genetic analysis; with parentage involving numerous genetic "markers," this can be strong proof, indeed.

We have, then, in this highly provocative volume, a full presentation of the work and views of an original and ingenious investigator studying a group of refractory organisms which seem to promise to supply important information on the relationships between cytological structures, genetic mechanism, and biochemical processes. The book should be read by all students of the genetics and cytology of microorganisms. One may not agree with Dr. Lindegren's views in many instances, but one is almost certain to find much to stimulate thought in this volume.

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*Therapeutische Chemie: Arznei- und Desinfektionsmittel zur Bekämpfung von Infektionskrankheiten.* Theodor Wagner-Jauregg. Bern, Switzerland: Hans Huber; New York: Grune & Stratton, 1949. 272 pp. Sw. fr. 35.50.

This is a valuable résumé of the chemistry of anti-infective agents. It is written in three sections, the first considering antiseptics such as phenolic, halogen-containing, and oxidizing compounds; the second, chemotherapeutic agents such as compounds containing metals, the dyes, and the sulfonamides; and the third, the antibiotics. The approach is chemical, with a concise statement of the history, derivation and relationships, and structure of the compound in question. Following this excellent chemical summary there is in most instances a brief, unqualified statement of the therapeutic claims advanced by the developers of the agent in question. There is seldom any criticism of these claims. For a few drugs—for instance, the sulfonamides and antimalarials—a short review of the pharmacology and practical therapeutics is added.

The book is similar to the excellent American volume, *Chemistry of Organic Medicinal Products*, by Jenkins and Hartung (New York: Wiley, 1949), to which it becomes a welcome and useful partner. It is, of course, limited to anti-infectives and includes some inorganic compounds. It is unlike the British volume, *The Basis of Chemotherapy*, by Work and Work (New York: Interscience, 1948), in that it considers the actual mechanism of action only briefly and occasionally. Wagner-Jauregg is an experienced worker and writer, particularly in the field of the chemotherapy of experimental tuberculosis. The German is easy, the printing and indexing are excellent, and the hundreds of structural formulas well set.

The printing date, 1949, prevents more than cursory statements in regard to the newest antibiotics, but penicillin and streptomycin are discussed in adequate detail, even with inclusion of considerable details of manufacture.

If one were to criticize the book at all it would have to be on the basis of its therapeutic credulity. It should

be consulted as a straightforward chemical source, not a therapeutic guide, and for this purpose should be an exceedingly valuable reference.

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## Scientific Book Register

*A Symposium on Steroid Hormones.* Edgar S. Gordon, Ed. Madison, Wis.: Univ. Wisconsin Press, 1950. 396 pp. \$6.50.

*German Aviation Medicine, World War II*, 2 vols. Prepared under the auspices of the Surgeon General, U. S. Air Force. Washington, D. C.: Supt. of Documents, Government Printing Office, 1950. 1302 pp. \$8.50 the set.

*Adrenal Cortex.* Transactions of the First Conference, November 21-22, 1949. Elaine P. Ralli, Ed. New York: Josiah Macy, Jr. Foundation, 1950. 189 pp. \$2.00.

*Amphibians of Western China.* Ch'eng-chao Liu. Chicago: Chicago Natural History Museum, 1950. 400 pp. and 10 plates. \$7.50.

*Maya Hieroglyphic Writing: Introduction.* J. Eric S. Thompson. Washington, D. C.: Carnegie Institution of Washington, 1950. 347 pp. and 64 plates. \$7.00 paper; \$7.50 cloth.

*Colloid Science.* James W. McBain. Boston: Heath, 1950. 450 pp. \$6.00.

*Statistical Decision Functions.* Abraham Wald. New York: Wiley; London: Chapman & Hall, 1950. 179 pp. \$5.00.

*The Technology and Chemistry of Alkaloids.* Frank E. Hamerlag. New York: Van Nostrand, 1950. 319 pp. \$6.50.

*McClung's Handbook of Microscopical Technique: For Workers in Animal and Plant Tissues.* 3rd ed. Ruth McClung Jones, Ed. New York: Hoeber, 1950. 790 pp. \$12.00.

*Freud: Dictionary of Psychoanalysis.* Nandor Fodor and Frank Gaynor, Eds. New York: Philosophical Library, 1950. 208 pp. \$3.75.

*An Introduction to Nematology: Anatomy*, Sect. I. Rev. ed. B. G. Chitwood and M. B. Chitwood. Washington, D. C.: B. G. Chitwood, Box 104, Catholic University, 1950. 213 pp. \$10.00.

*Soil Fertility and Sewage: An Account of Pioneer Work in South Africa in the Disposal of Town Wastes.* J. P. J. Van Vuren. New York: Dover, 1950. 236 pp. \$4.50.

*Physical Chemistry.* Walter J. Moore. New York: Prentice-Hall, 1950. 592 pp. \$5.00.

*Biological Standardization.* 2nd ed. J. H. Burn, D. J. Finney and L. G. Goodwin. New York: Oxford Univ. Press, 1950. 440 pp. \$6.75.

*The British Smut Fungi (Ustilaginales).* G. C. Ainsworth and Kathleen Sampson. Kew, Surrey, Engl.: Commonwealth Mycological Institute, 1950. 137 pp. \$3.00.

# News and Notes

## The Seventh International Botanical Congress

A. C. Smith

Division of Phanerogams, Smithsonian Institution and AAAS Representative

The Seventh International Botanical Congress was held at Stockholm, Sweden, July 12-20. This congress had been planned for 1940; because of its postponement a period of 15, rather than the normal 5, years had elapsed since the Sixth Congress, held at Amsterdam in 1935. More than 1,500 delegates, many accompanied by members of their families, took part in the Stockholm meeting. The president of the congress, Carl Skottsberg, opened the first plenary session on July 12, introducing to the delegates H.R.H. the Crown Prince, who welcomed them to Sweden. Formal invitations to hold the Eighth Congress were received from representatives of France, the United States, and Canada, and a Resolutions Committee to consider these invitations was appointed.

The plenary sessions were held in Concert Hall, near the center of the city, and congress headquarters and the sectional meetings were at the conveniently located University of Stockholm, where adequate meeting rooms and projection equipment were available. The congress was divided into 15 sections, which held concurrent or joint meetings throughout the period. More than 600 formal papers were presented in 14 of the sections, the discussions in the Section on Nomenclature being general. Of course, each delegate could hear only, comparative few of the papers, which will be abstracted in the *Proceedings* of the Congress.

On the afternoon of the opening day the Crown Prince received the delegates at the Royal Palace of Drottningholm. On July 13 several excursions to various islands of the Stockholm Archipelago were made, permitting the delegates to see this region under ideal conditions. On July 15 the members visited three of the botanical institutions near Stockholm—the Forest Research Institute, the Natural History Museum, and the Bergius Botanic Garden. On the following day there was a general excursion to Uppsala, where delegates examined the university, Linnaeus' botanical garden, and his estate in near-by Hammarby; this was followed by a dinner for all delegates at the famous castle in Uppsala.

Before and after the congress numerous excursions were made, covering practically all parts of Sweden and lasting, in some cases, for more than two weeks. These excursions offered the delegates an unparalleled opportunity to visit remote parts of Sweden under the guidance of expert leaders. The committee in charge of the excursions and the numerous individuals who acted as leaders deserve the utmost credit for their enthusiasm and generosity.

At a final plenary session on July 20 the congress approved the decisions made by the various sections. The

report of the Resolutions Committee was received and approved, and it was agreed to hold the Eighth International Botanical Congress at Paris, probably in 1954. It was decided that, in the future, meetings will be alternated between Europe and some non-European country, and that the intercongress period will be shortened to 3 or 4 years, when possible.

All delegates to the Stockholm Congress will agree that the meetings were eminently successful and enjoyable. The natural beauties of the city and country, the excellent organizational work of our hosts, and the cooperation of officials of the Swedish government combined to make this largest of international botanical congresses a very memorable one.

### NOMENCLATURE

Although the work of the Section on Nomenclature is specialized, the decisions made by this section and approved by the congress as a whole affect, in one way or another, every botanist; consequently, it is felt that a report on the Stockholm Congress from this point of view will be useful.

The Section on Nomenclature, under the joint presidency of E. D. Merrill and T. A. Sprague, began its deliberations in advance of the congress, on July 7. It was hoped that the work of this section might be completed by July 12, but three additional sessions were held after the opening of the congress, a total of 11 half-day sessions being necessary for the completion of business. Faced with a 255-page "Synopsis of Proposals," prepared by the *rapporteur général*, J. Lanjou, the delegates were expected to reach decisions to accept or reject (or modify) each proposal concerning the present (third) edition of the *International Rules of Botanical Nomenclature*. That the task was completed at all was due to the excellent preliminary work of Dr. Lanjou and his associates, to the skillful handling of the meetings by the presidents, to the zeal of numerous committees and their chairmen, and to the good will and cooperation of the delegates in reconciling their often divergent opinions. The average attendance at each session of the section was more than 100.

On the first day the *rapporteur général* explained the basis upon which the organizing committee of the congress had allotted votes for use in the Section on Nomenclature. Votes were automatically granted to members of committees, members of the Bureau of Nomenclature, and proposers of changes in the *Rules*. The greater number of votes, however, were allotted to botanical institutions and organizations throughout the world, ac-

cording to their size, number of workers, and activity, with a maximum of 5 votes. The organizing committee weighed all requests for voting privileges and was generous in allotting them. Voting upon each question was by a show of hands unless the decision was close, in which case secret ballots were used. On only ten occasions were ballot votes taken, and these indicated that approximately 360 votes had been allotted by the organizing committee (or at least had been claimed by delegates).

Preliminary voting forms had been distributed in advance of the congress with the "Synopsis of Proposals"; a tabulation of the preliminary vote was made available to the delegates. In order to save time, it was agreed not to discuss any proposal which failed to receive at least one-third of the votes in the preliminary balloting, unless the proposer, or someone acting for him, wished to explain the proposal and ask for reconsideration. After the first 2 days it was further agreed to limit each speaker to 2 minutes and to permit him to speak only once on each proposal. Although this agreement was not strictly enforced, it served to keep the debate within reasonable limits.

It is not possible here to mention all the changes made in the *Rules*, but those of particular consequence will be briefly discussed, the order of articles being that of the current *Rules*.

Art. 8 was modified to permit the use of a recently coined word, *taxon* (plural: *taxa*), in place of "taxonomic group." The adoption of this proposal will mean many changes throughout the text of the *Rules*; the word *taxon* has already met with uniform approval among systematic botanists, many of whom use it in their writings.

Art. 18. This is the article which discusses the type method. Numerous suggestions for revising the article had been received, and the task of coordinating these was so formidable that a special committee was appointed to consider the whole matter of the type method, which is so fundamental a part of our current system of nomenclature. This committee composed a substitute for the present Article 18, considerably expanding and clarifying it, which was accepted by the Section on Nomenclature.

Art. 21. This article, which limits the principle of priority by providing for the conservation of generic names, was expanded to provide for the conservation of names of taxa above the rank of genus. Many proposals had been submitted to permit the conservation of specific names or at least to list certain names as *nomina excludenda*. After considerable discussion of this fundamental matter, the section rejected the principle of *nomina specifica conservanda* by a ballot vote of 320 to 40. Similarly, the principle of *nomina specifica excludenda* (*rejienda*) was rejected by a vote of 242 to 116.

Art. 28 bis, a new article, was adopted. This makes it mandatory to repeat the specific epithet for any taxon of lower rank than a species which includes the type of the species, if it is to be referred to by name. Such an epithet is to be used without citation of an author's name, and the principle of priority does not apply to it. This is perhaps the most consequential change made by

the Section on Nomenclature at Stockholm. As a corollary, another new article, numbered 68 bis, declares illegitimate subdivisional epithets such as *typicus*, *originarius*, and *genuinus*. The result of this legislation will mean the substitution of the repeated specific epithet for the many thousands of varieties *typicus* in current usage.

Arts. 31-34 make up Subsection 6 of Section 4 of the present *Rules* and deal with names of hybrids, etc. In recent years it has become apparent that these articles are inadequate to provide for the complicated situations faced by experimental taxonomists. A special committee considered the numerous proposals to revise this subsection and recommended a new and expanded text for Articles 31-34. This new text, subject to minor changes by the Editorial Committee, was accepted by the Section on Nomenclature.

Art. 35, dealing with names of plants in cultivation, was also greatly in need of revision, in view of modern progress in the taxonomic understanding of such plants. This article was reworded and expanded, and a special committee was appointed to draw up an amplified appendix dealing with the nomenclature of cultivated plants.

Art. 63 and Rec. XXXVII, dealing with *nomina dubia*, were deleted. It was the majority opinion of delegates that only a specialist can decide whether a name is "dubious," and that legislation discussing such names is not desirable.

Arts. 62 and 64, dealing with *nomina ambigua* and *nomina confusa*, provided for lists of names to be abandoned (Appendices IV and V, thus far never compiled). It was felt that such lists are not desirable, and the provision for their compilation was deleted. As now worded, the articles leave the decision as to whether names are ambiguous or confused to the discretion of workers.

Art. 69 discusses the selection of a new name or epithet for a group for which no legitimate epithet exists. An author may select for such a taxon an epithet previously given to the group in an illegitimate combination; but it is now positively stated that the resultant combination is treated as a new name.

Rec. XLIII is the much discussed recommendation dealing with the capitalization of specific epithets. It was reworded in such a way that the emphasis has been shifted; i.e., it is now recommended that all specific and trivial names be written with a small initial letter, but provisions for the traditional use of capitals in certain special cases remain in the recommendation for those who wish to use them.

The foregoing discussion summarizes only the most outstanding changes that were made in the *Rules*, and it will be seen that most of these are secondary in nature. Special committees that had been working during the intercongress period on problems in the nomenclature of fungi and fossil plants presented their suggestions to the section, and their reports were accepted, subject to modification by the Editorial Committee. Such reports are too detailed and specialized to be discussed here. The long lists of generic names that were proposed for conservation were referred to the appropriate committees for consideration.

An important development took place at a brief joint meeting of the Section on Nomenclature and the Sections on Taxonomy (Phanerogams and Cryptogams). An International Association of Plant Taxonomists was established, and a committee to organize the initial phases was

appointed, with C. Baehni (Geneva) as president and J. Lanjouw (Utrecht) as secretary. Botanists throughout the world interested in taxonomy and related subjects will be informed concerning membership in the new association in the near future.

## About People

**George Gelman**, technical director of the Quartermaster Food and Container Institute for the Armed Forces, has resigned to accept appointment on November 4 as vice president of the Vico Products Company, Chicago, manufacturers of yeast, yeast derivatives, hydrolysates, and vitamins.

**C. M. Hasselmann**, chairman of dermatology and venereology and chief of clinics at Erlangen University, American Zone of Germany, has been appointed expert adviser for a yaws control project being conducted in Indonesia by WHO, the UN International Children's Emergency Fund, and the Indonesian government. He succeeds **Frederick R. Hill**.

**Donald Mainland** has been appointed professor of preventive medicine in charge of medical statistics at New York University College of Medicine. He was formerly professor of anatomy at the School of Medicine of Dalhousie University, Halifax, Nova Scotia, and is at present engaged in research on the relation of aging to changes in bones and joints.

**Fillmore H. Sanford**, formerly of Haverford College and the Institute for Research in Human Relations, is the new executive secretary of the American Psychological Association. He replaces **Dael Wolfe**, who on October 1 became director of the Commission on Human Resources. The commission's purpose is to assess the national supply and needs for top-level talent in all fields that require long education and training. Sponsoring the commission are the American Council of Learned Societies, the American Council on Education, the National Research Council, and the Social Science Research Council.

**Roman Smoluchowski**, professor of metallurgical engineering at Car-

negie Institute of Technology, has been appointed a consultant to the chairman of the Research and Development Board on matters pertaining to research in the field of physics and solids.

**Joel Stebbins**, research associate at the Lick Observatory, University of California, will deliver the George Darwin Lecture before the Royal Astronomical Society, London, on October 13. He will also speak before the Royal Society of Edinburgh and at the Universities of Glasgow and Cambridge.

## Visitors

**Jean Glangeaud**, professor of geology at the University of Besancon, France, is visiting the U. S. Geological Survey, Washington, D. C., and may be reached there through W. D. Johnston, Jr., or Francis G. Wells. **Bertil Hallert**, professor of photogrammetry at the Royal Institute of Technology, Stockholm, Sweden, was a recent visitor at the Survey.

**Boris Ephrussi**, professor of genetics, Laboratoire de Génétique, University of Paris, will deliver the second Harvey Lecture of the current series at the New York Academy of Medicine on October 26. Dr. Ephrussi will speak on "The Interplay of Heredity and Environment in the Synthesis of Certain Respiratory Enzymes in Yeast."

## Grants and Awards

G. L. Royer was awarded the **Olney Award Medal**, presented annually for outstanding achievement in the field of textile chemistry, including the development of chemical agents or chemical processes used in the manufacture of textiles or methods for their evaluation. The award was made September 30 at the 29th annual convention of the American Association of Textile Chemists and Colorists.

The **Howard N. Potts Medal** will be awarded by the Franklin Institute to Merle A. Tuve, director of the Department of Terrestrial Magnetism at Carnegie Institution, on October 18. Dr. Tuve was cited for his leadership in developing the first workable proximity fuse, which played a major role in World War II.

The National Academy of Sciences conferred the **John J. Carty Gold Medal and Award** upon Irving Langmuir, recently retired associate director of the General Electric Research Laboratory at the academy's autumn meeting on October 11. In addition to the medal the bestowal carries with it the award of the net accumulated income since the time of the preceding award.

## NRC News

**Particle and Quantum Detectors**, Preliminary Report No. 7 of the NRC Nuclear Science Series, is available without charge to workers in nuclear science. The report is one of a series being compiled by the Committee on Nuclear Science of the NRC's Division of Mathematical and Physical Sciences, and it is planned to publish the complete work later as a handbook of nuclear instruments and techniques. Report No. 7 was prepared by R. R. Wilson, D. R. Corson, and C. P. Baker, of Cornell University. It includes sections on ionization, proportional and Geiger counters, and on electron multipliers and scintillation counters. Pulse shape, pulse time, electronic amplification, and similar characteristics and techniques are discussed for each type of detector.

A second edition of *Survey of Food and Nutrition Research in the United States* has been prepared by the NRC's Food and Nutrition Board. The new survey, covering 1948-49, includes nearly 4,500 research projects being conducted by



650 academic, industrial, and government laboratories in numerous fields of research under major classifications of physiology, chemistry, technology, microbiology, food acceptance, and nutrition education. A list of organizations supporting or conducting research in food and nutrition is included.

The publication can be obtained from the Office of Technical Services of the U. S. Department of Commerce, for \$1.75.

### Industrial Laboratories

**Bausch & Lomb Optical Company** has appointed Kuan H. Sun as a special consultant in optical glass research. Dr. Sun will collaborate with Norbert J. Kreidl, head of Bausch & Lomb's Chemical Laboratory, on the behavior of glass under radiation, including high-energy gamma rays and neutrons.

Pulverization of previously hard or impossible-to-grind materials now can be accomplished by a method developed by **The Linde Air Products Company, of the Union Carbide and Carbon Corporation**. The new technique uses liquid nitrogen, in spray form, to cool the material rapidly to a point of maximum fragility, and thereby reduce the amount of energy required for its fracture. The new process promises to accelerate the high-speed pulverization of mechanically-tough or heat-sensitive materials such as plastics, pharmaceuticals, insecticides, foodstuffs, substances containing vitamins, and other organic materials.

### Meetings

A symposium on shock and vibration will be held October 18-19 at the Armour Research Foundation in Chicago, under the sponsorship of the Department of Defense Research and Development Board. Elias Klein and Arthur Park, of the Naval Research Laboratory, which is conducting the meetings, are in charge of arrangements. Additional information, including subjects of papers to be presented, may be obtained from Mr. Park, Naval

Research Laboratory, Washington 25, D. C.

**The National Malaria Society, American Society of Tropical Medicine, and the American Academy of Tropical Medicine** will hold joint annual meetings at the Hotel DeSoto, Savannah, Ga., November 6-10. In addition to scientific reports on the latest advances in the field, two symposia—"Nutrition in Relation to Tropical Medicine" and "Nation-wide Malaria Eradication Projects in the Americas"—will be held. Outstanding workers in the Western Hemisphere have been invited to participate in the symposia.

**The third Inter-American Congress on Brucellosis** will be held in Washington, D. C., November 6-10, under the auspices of the Inter-American Committee on Brucellosis, the Committee on Brucellosis of the National Research Council, and the Pan American Sanitary Bureau, regional office of WHO. Governments throughout the Western Hemisphere have been invited to send official delegates, and all physicians, veterinarians, medical technicians, bacteriologists, and professional persons interested in the study and control of brucellosis are invited. Representatives from England and Europe will also attend. The main objectives of the congress are the exchange of ideas on techniques of combating brucellosis and discussion of related scientific work, with the aim of establishing uniform methods of diagnosis and improving treatment and control. The program will include papers on epidemiology, bacteriology, research and clinical observations on human brucellosis, veterinary research, and control of brucellosis. Open discussion will follow each paper. Sessions will be held at the Departmental Auditorium, Department of Commerce. On Wednesday, November 8, delegates will visit the National Institutes of Health, Bethesda, Md., and the laboratories of the Bureau of Animal Industry, Beltsville, Md. The registration fee of \$5.00 includes a copy of the printed proceedings. Further information may be obtained from Dr. Wesley W. Spink, Chairman of

the Organizing Committee, University Hospitals, Minneapolis 14, Minn.

### Miscellaneous

**The Nature Conservancy** is the new name which was adopted by the former Ecologists Union at its annual meeting in Columbus, Ohio, September 11.

Officers elected include Stanley A. Cain, of the University of Michigan's School of Natural Resources, president; George B. Fell, of Washington, D. C., vice president; and Joseph J. Hickey, of the University of Wisconsin, secretary-treasurer. William Vogt was elected to the Board of Governors. Former members of the board still serving are Richard H. Pough, of the American Museum of Natural History, and Victor E. Shelford, of the University of Illinois.

Principal work of the organization is carried on by the Committee on the Study of Plant and Animal Communities, under chairmanship of S. Charles Kendeigh, University of Illinois, and the Committee for the Preservation of Natural Conditions, of which Dr. Pough is chairman.

Purpose of the Nature Conservancy, as stated in its constitution, includes "the preservation of adequate samples of all biotic communities and other features in each distinctive natural region, and the encouragement of the study of these communities." Emphasis will be placed on saving small natural areas for their scientific, educational, and aesthetic values. An extensive program of acquisition and preservation activities is being planned in cooperation with local groups and agencies in all parts of the country.

The Nature Conservancy maintains an office at 1214 Sixteenth St., N.W., Washington 6, D. C.

The editors of *Growth* have for sale a limited number of *Growth* symposia at the reduced rate of \$1.50 per copy. The complete series, Symposia 1-4, 6, 7, and 8 (proceedings of the fifth symposium were never printed), is \$10 per set. Orders should be mailed to the Editorial Office, *Growth*, Fox Chase, Philadelphia 11, Pa.



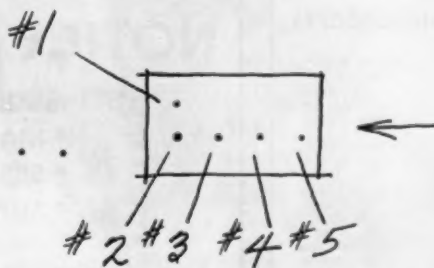
North

### The case of the occasional flasher

There's a nearby but faint, cool, small star, catalogued L-726-8, that seemed no different from the other unvarying stars in the heavens until Willem J. Luyten of the University of Minnesota, examining its image on a Kodak Spectroscopic Plate, noticed an oddity. At unpredictable intervals, L-726-8 flares up by almost two magnitudes and then in a few minutes sinks back to the 13th magnitude.

Why this little fellow should take it into its head once in a while to emulate a nova, no one knows. Some night, doubtless, a credible answer will be supplied by photography, which this year observes its centenary of partnership with astronomy.

A new 112-page Kodak book, "Photography in Astronomy," provides an introduction to the photography of the night sky. It discusses properties of sensitized materials and the reproduction of astronomical photographs. It's available from your Kodak dealer at \$2.75. Eastman Kodak Company, Rochester 4, N. Y.



Multiple exposure by E. F. Carpenter on a Kodak Spectroscopic Plate, Type 103a-0. Five images of L-726-8 are marked. The very bright one is #2. Twenty minutes elapsed between the first and last, each exposure was two minutes.

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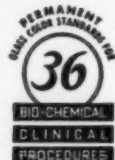
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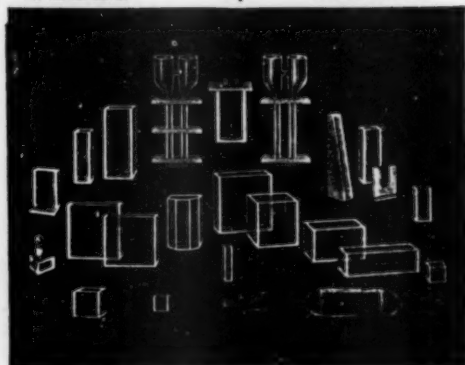
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1. You avoid congestion and delay at the Registration Desks in busy foyers at time of arrival. All indications point to a large attendance since all of the Association's seventeen sections and subsections, and more than forty societies, will have sessions with excellent programs and there will be a number of important symposia.
2. You receive the General Program early in December in ample time, unhurriedly to decide among the events and the sessions that you wish to attend.
3. Your name and hotel address will be in the enlarged Visible Directory the first hour of the first day of the meetings, since it will be posted in Washington as soon as processed.
4. Advance Registrants will have the same privileges of receiving a map and directory of points of interest of Cleveland, literature, radio broadcast tickets, etc. At the convenience of Advance Registrants, these will be distributed from the Main Registration in the Public Auditorium—the location of the Annual Science Exposition, the Visible Directory, and the Science Theatre. Admission to the splendid series of latest scientific films will be free to all Registrants.

At the 1949 Meeting, the Council of the AAAS voted overwhelmingly to continue Advance Registration. To insure its prompt receipt, the General Program will be sent by *first class mail* December 1-4, 1950—which is also the *closing date* for Advance Registration.

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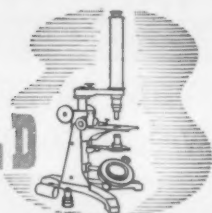
Energy saved *inside* a microwave station can be used in the radio-relay path *outside*. So stations can sometimes be spaced farther apart, with more margin against fading. Here is another example of the practical value of research at Bell Telephone Laboratories.


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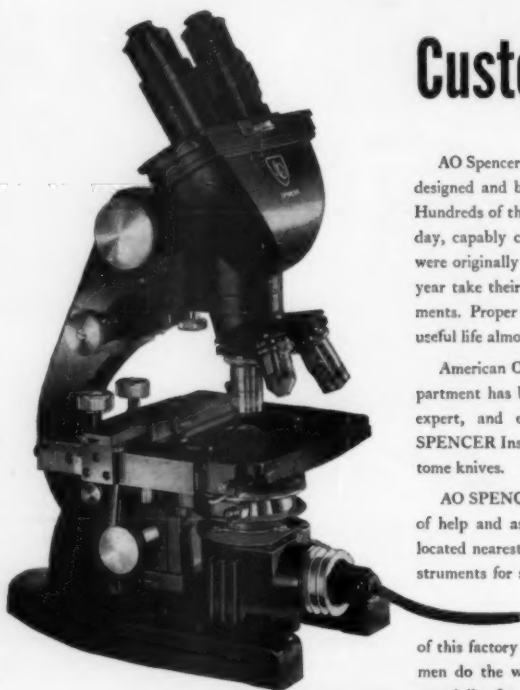


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AO SPENCER Branch Offices are always glad to be of help and assistance to you. Why not call the one located nearest to you for guidance in packing your instruments for shipment to the factory. Upon receipt of your instruments, quotations will gladly be furnished. Take advantage of this factory service where only factory trained workmen do the work with tools and machinery designed especially for this purpose. For further information write Dept. K2.

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